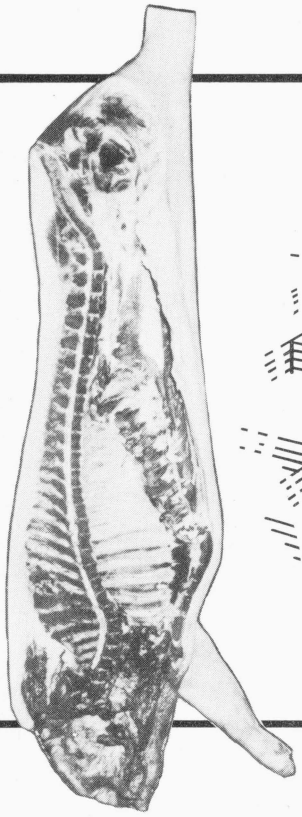
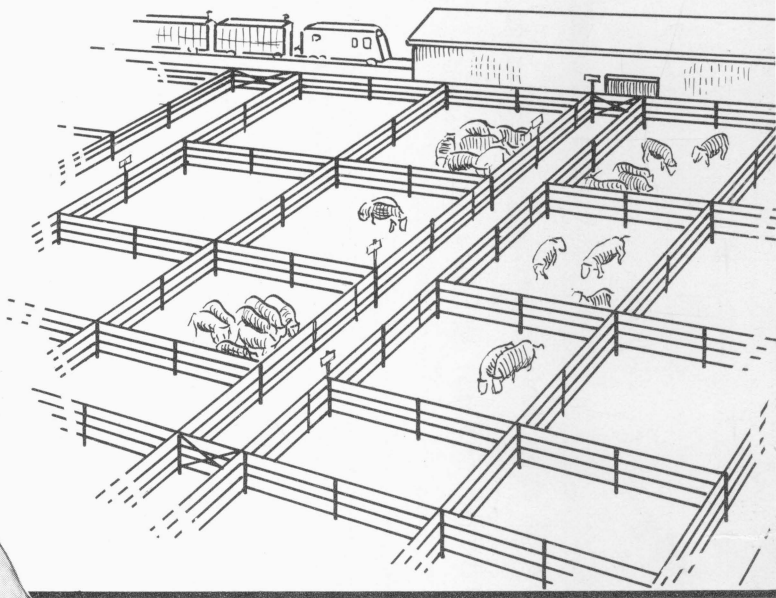
Research Bulletin 728 June 1953

MARKET HOGS can be Accurately Graded





George F. Henning Merrill B. Evans

What determines carcass cutout values, and how such factors can be used in grading live market hogs.

Ohio Agricultural Experiment Station
Wooster, Ohio

For Your Information:

Bulletin 728 on grading market hogs is forwarded to you with the hope that it may be used as a guide for the improvement in the buying and selling of hogs.

Will you please note the following corrections in printing errors:

Page 33 - $Se^2 = Sy^2 - \sum b_x Sx_x y$

Page 54 - Table 22 is shown on page 64.

Page 60 - Picture should be on page 62, representing the No. 3 hog.

Page 61 - Picture should be on page 60, representing the No. 1 hog.

Page 62 - Picture should be on page 61, representing the No. 2 hog.

George F. Henning
Merrill B. Evans

FOREWORD

The marketing of hogs in the United States based on an average price per hundredweight per live weight group, has not been entirely satisfactory to many segments of the swine industry. Other countries, notably Denmark and Canada, have developed a method of marketing hogs on the basis of carcass weights and grades. This method has intrigued many in this country.

For several decades some of the livestock marketing representatives not only in the educational and research field, but also some of the active interests engaged in marketing hogs, have concerned themselves with ways, means, and methods of improving the system of marketing swine. Several research projects and studies in recent years were conducted with the aim of initiating an interest in the improvement of swine marketing.

Following World War II, it was the conviction of many of the members of the North Central, (Corn Belt) Livestock Marketing Research Committee, that a regional project should be initiated to determine the basic facts that would lead to an improved system of marketing hogs. In 1948, this North Central Committee initiated such a regional research study. Ohio has contributed its part to this regional study, and the findings have been published in the North Central Regional Publication, No. 30, by the Agricultural Experiment Station, University of Minnesota, Bulletin No. 414.

Those responsible for Ohio's share of the research for the region, have conducted additional studies exploring the possibilities of developing other methods to improve the system of marketing hogs. This publication is a result of that research. There are two phases to this study which are presented in this bulletin. Part I is concerned with the basic factors influencing the differences in the cut-out performance of hogs as shown by carcass cut-out value, and contains statistical procedures to analyze adequately the carcass data so that basic standards may be developed. In Part II the standards are applied to the marketing of live hogs. Comparisons are made to the application of these standards to a live grading and a carcass grading system.

Data were obtained on 540 carcasses for analysis in Part I and on 878 hogs in Part II.

Many readers may find Part I too technical, but should have no difficulty with the other sections of this bulletin. For those readers who desire to omit Part I, please refer to Part II for the practical application of grading market hogs.

CONTENTS

ACKNOWLEDGMENTS

The writers acknowledge the invaluable assistance received during preparation of this report.

Acknowledgment is due to the entire Armour and Company organization (and particularly the Columbus Packing Company) for lending its facilities and supplying help in the collection of these data. Special thanks to K. E. Miller and E. J. Frank* of the Commercial Research Department in Chicago, Illinois, and to A. L. Leonard*, F. M. Ward, and H. M. Everhart of the Columbus Packing Company.

The writers are indebted particularly to L. E. Kunkle of the Ohio Agricultural Experiment Station for his help and information concerning the grading and cutting of the hog carcasses. Acknowledgment is due also to the personnel of the Production and Marketing Administration, United States Department of Agriculture for their efforts in grading the hog carcasses.

Special appreciation is hereby expressed to some of the members of the Department of Agriculture Economics, the Ohio State University for critically reading this manuscript and for helpful suggestions.

G. F. HENNING
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MARKET HOGS CAN BE GRADED ACCURATELY

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General Summary

In the United States hogs are sold primarly on a live weight basis with little regard to quality and finish. Dissatisfaction with this method of marketing hogs has been instrumental in developing research programs designed to improve the present system of marketing hogs.

The primary purpose of this study was to determine whether the present system of marketing hogs could be improved. Previous to this research, however, little has been done to improve the method of marketing hogs so that the farmer would be compensated properly for producing hogs of higher value.

This study is divided into Parts I and II. Part I deals with the more technical and statistical aspects of this research, while Part II contains the practical application of this research.

The main objective of Part I was to determine the factors in hog carcasses which influence the percentage yield of the trimmed four lean cuts[1] (hams, loins, picnics, and butts), and ultimately, the value of hogs. The development of a set of grade standards from carcass data based on variation in the percent of four lean cuts was the goal of this part.

The results of Part I can be summarized, briefly, as follows:

1. Present carcass grades used by packers do not reflect adequately the individual grades of hams, loins, and bellies. Carcass grades should reflect the differences in the value of carcasses produced by each individual wholesale pork cut.

2. The trimmed four lean cuts expressed as a percentage of carcass weight comprise from 65.0 to 70.0 percent of the total carcass value of a hog. The inclusion of the bellies increases this total percentage to 80.0 to 85.0 percent of the total carcass value.

3. Nine factors explained 94.5 percent of the variation in the four lean cuts of hogs, but the four most important physical factors were: average backfat thickness, hind leg length, body length, and carcass weight. Since scales are used to determine the weight for settlement of purchase, weight need not be considered as a factor since hogs can be classified easily into weight groups. Average backfat thickness as a single factor explained 66.9 percent of the variation, while the addition of hind leg length and body length increased the total accountability to nearly 72.0 percent.

[1]When reference is made in this bulletin to the four lean cuts, it means the trimmed four lean cuts.

4. Cooler temperatures are important in determining the final cut-out performance of hog carcasses. Light hog carcasses shrink more than heavy carcasses. On the average, carcasses will shrink slightly more than 2.0 percent in a 24 hour period, varying from 2.0 to 3.0 percent for most carcasses. A second 24 hour period will add about one half of one percent resulting in a 48 hour shrink of slightly more than 2½ percent. Fat type carcasses tend to have less shrink than meat type carcasses.

5. A tentative set of grade standards based on carcass data was developed which were tested for applicability (Part II) in the live hog.

The main objective of Part II was to determine if hogs could be graded accurately to reflect value differences. This involved taking the standards as developed in Part I from carcass data, and testing their applicability on various methods of grading hogs.

The application of these principles in live hog grading produced results that point to several possibilities for improving the system for grading and buying hogs. The results of Part II can be summarized, briefly, as follows:

1. Four graders, who were assigned to live grade 105 hogs, were fairly consistent in their estimates of average backfat thickness, hind leg length, and body length. The graders estimated average backfat thickness within plus or minus 0.2 inches of the actual measurement for nearly 75 percent of the hogs. Their estimates of average backfat thickness between weight groups were consistent and their fluctuations small. While some graders estimated the length measurements better on certain weight groups than others, from 50 to 80 percent of the hogs were placed within plus or minus one inch of the actual measurements for hind leg length and body length.

2. When graders were assigned to live grade 773 hogs, divided into 16 lots, at a rate comparable to normal buying conditions, their results indicated that live grading of hogs on this basis can be accomplished, with grading accuracy being dependent upon experience. One grader placed from 40.5 to 64.4 percent of the hogs, by lots, in the correct grade.

3. Comparison of individual live grading with the carcass grading by inspection for 432 hogs revealed about the same percentage of accuracy, with a slightly better accuracy for carcass grading.

4. The carcass grading of 664 carcasses by the measurement of average backfat thickness alone revealed a percentage of accuracy in the correct grade ranging from 52.6 to 80.0 percent for all grades and weight groups. Carcass grading, based on the measurements of average backfat thickness at three points, was better than carcass grading by inspection. The possibility of relying solely on average backfat thickness works well with a typical or average hog in each grade, but when one departs from this type of hog, the influence of the length factors must be taken into consideration in determining the final grade.

5. Analysis showed that the live price currently paid for hogs does not reflect the actual value of the four lean cuts based on cut-out performance in the proper live grade. Over 95.0 percent of the 425 hogs graded were worth more than the actual live price quoted on the day of purchase. This in no way implies that the packers bought these hogs at bargain prices, but it does mean that the current method of live pricing (the present system) does not reflect differences in the cut-out performance of hogs.

6. A revision of the tentative grade standards as established in Part I, was developed from the application of these standards to additional hogs. These standards are based on three grades of hogs for each weight group as follows: grade 1 (above average percent of four lean cuts), grade 2 (average percent of four lean cuts), and grade 3 (below average percent of four lean cuts). These final standards include an overlap in the percent of four lean cuts of grades 1 and 2, and grades 2 and 3. The amount of this overlap varies with the weight group of hogs. These standards may be used as a guide by the hog buyer and hog salesman to indicate the range of physical measurements that a graded hog should attain.

Recommendations

Results of this study have indicated various possibilities of improvement in the present system of marketing hogs. Exploration of these possibilities has emphasized inherent weaknesses in the present system, and has paved the way for the incorporation and practical application of some changes.

Consumer demand for pork with less fat has become widespread. The present marketing system is neither designed to give consumers a lean (less fat) meat type hog, nor does it encourage farmers to produce this meat type hog, therefore, the present system of buying hogs should be "overhauled" and modernized.

The livestock marketing interests and the meat processing industry have the final decisions to make on the following suggestions for improvement:

1. Adoption of an improved live weight and grade method providing for differentials that would recognize differences in values within given weight groups. The weight groups should be selected so that hogs are classified by differences of 20 to 25 pounds. For example, 170 to 195 pounds, 195 to 220 pounds, etc. — live weight. Within each weight group the writers suggest three grades representing differences in value (See Section X of this bulletin). Purchasing could be based on individual grading of live hogs or grading by lots. **or**

2. Adoption of a method of purchases based on carcass weights and grades, or some modification of this method. This grading can be accomplished by carcass inspection or carcass measurement, or by some combination thereof. **or**

3. A combination of live grading and/or carcass grading. Some processors do and others might want to give farmers a choice of selling either way.

The three methods have inherent advantages and disadvantages which need to be considered. Some method may be more adaptable to a particular type of operation. The livestock and meat industry should weigh the gains and losses of each method, and make any final decision whether to accept, reject, or modify any particular method. This means taking advantage of the research now available, and pioneering in the suggested improvements.

As a result of this research the writers are convinced that market hogs can be graded accurately before slaughter. The processing industry should begin buying hogs on a live weight and grade basis so that live grading accuracy can be improved with grading experience. As the system of live grading becomes more accepted, the writers believe that live grading experience will lead eventually to further improvement in marketing hogs.[1]

This further improvement should be towards a combination live and/or carcass grade and weight method, or to a method of marketing based entirely on carcass weight and grade.

The writers are convinced beyond doubt that the time has arrived to bring about an improved system of buying and selling hogs for slaughter, so that the farmers will be compensated for producing the leaner, meat type hog now demanded by consumers. Such an improved system will give the impetus that is needed to bring about the superior meat type hogs, which should enable the commercial hog producer to meet present day and future demands for more lean meat.

Part I is the statistical analysis, involving 540 hog carcasses, which may be too technical for most readers. However, it is the basis for arriving at the standards upon which Part II depends. The practical application of grading market hogs is shown in Part II.

[1]By January 1, 1953, slightly more than 100,000 hogs have been graded in Ohio, following the suggested standards developed in this study.

An Analysis of the Factors which Influence the Variation in the Percentage Yield of the Four Lean Cuts (Hams, Loins, Picnics, and Butts) of Hogs[1]

PART I

SECTION I — INTRODUCTION

In 1949, 4.7 million hogs were marketed in Ohio, amounting to 196.4 million dollars and representing 60.1 percent of the Ohio farmers cash receipts from livestock sold for meat purposes. This was 20.8 percent of the cash receipts from all farm commodities sold in Ohio.

Since hogs have been marketed primarily in the United States on an average live weight basis for many years, the possibilities of improvement in the method of marketing hogs is often discussed. Differences in grades of cattle, calves, and lambs have been recognized for many years, and considerable emphasis has been placed upon the type, finish, and quality of these animals. Hogs have been marketed primarily by weight with little emphasis upon other factors. Processing and merchandising methods of hog carcasses are much different from those used for other meat animals. Beef, veal and lamb carcasses retain their individual identity to a large degree while hog carcasses are processed at the packing plant into hams, loins, picnics, butts, bellies, etc. The possibility of placing greater emphasis upon type, finish, and quality of hogs has introduced the problem of whether the live weight method of buying hogs could be improved so that the full value of the hog carcass would be realized.

Since 1920 considerable research has been conducted to improve the efficiency of hog production. Previous to this research, however, little has been done to improve the method of marketing hogs so that one farmer would be compensated properly for producing hogs of higher value, compared to another farmer for producing hogs of lower value.

Purpose and Objectives

The primary purpose of this study was to determine whether the present system of marketing hogs could be improved. The authors believe that before any complete change in the method of marketing hogs is undertaken, the present system should be examined to see if it can be improved. Some of the objectives of Part I were:

1. To investigate what characteristics accounted for the differences in the percentage yield of the four lean cuts (hams, loins,

[1]This study is part of a regional project sponsored by the North Central Livestock Marketing Research Committee entitled "Marketing Slaughter Livestock by Carcass Grade and Weight." It is not contradictory to the regional study, but includes wider adaptations that are applicable to the marketing of hogs in Ohio.

picnics, and butts)[1] between hogs of approximately the same weight and grade, and to what extent these characteristics can be recognized in the live hog.

2. To determine the shrinkage of hog carcasses of different weights and grades.

3. To develop standard specifications based on variation in the percent of four lean cuts that are applicable to live grades of hogs.

4. To find and point out the characteristics of a live hog which will reveal more accurately the yield and ultimately, the value of a hog carcass.

Hog buying practices should be improved to help the hog buyer do a better job of buying hogs, which in time will be of benefit to the entire swine and meat industry.

The Ohio Agricultural Experiment Station collected data on 540 hog carcasses at the Columbus Packing Company (Armour and Company) in Columbus, Ohio. This work was started in June, 1948, and continued through June, 1949. This period was covered to get carcasses from both the spring and fall movements of hogs. Some portions of the analysis of Part I will include all 540 carcasses and others will be concerned with varying numbers, depending upon the type of analysis.

SECTION II — THE PRESENT SYSTEM OF MARKETING HOGS (LIVE WEIGHT)

At present, hogs are bought primarily on a live weight group basis with an average price paid per 100 pounds. This system of marketing hogs has been used chiefly in the United States for the past century and still is being used by most meat packers.

How it Operates

Under this system of buying hogs on an average weight basis, purchases are made according to the live weight group classification and little consideration is given to potential cut-out performance. Using this method, one can sell two live hogs of approximately the same weight, but with different type and finish, and receive the same price for both hogs. Wholesale cuts from these hogs have considerable variation in both weight and value.

Who Gains and Who Loses

It means that farmers bringing groups of hogs to market have been underpaid for some and overpaid for others. Producers of hogs with high cut-out performance are penalized and the producers with low cut-out performance gain.

The packing industry is in the middle and cannot be blamed solely for discrepancies in estimated yields. It continues to buy hogs on an average price per live weight classification to maintain a margin of safety, whereby its underestimates of cut-out tend to exceed its overestimates in the long run. Cut-out tests conducted by the packing industry have been concerned primarily with lot or with daily average

[1]Each expressed as a percentage of the carcass weight.

yields, rather than with emphasizing any differences in individual carcass cut-out.

Another element to consider is the demands of the consumer and how the consumer is affected by the present method of buying hogs. The consumer is interested primarily in obtaining retail cuts of pork which have the largest amount of edible lean meat, consistent with quality and tenderness. Yet, when hogs are bought on a live weight group classification basis, the packer pays the same price for a 220 pound fat type hog and a 220 pound meat type hog. The consumer is interested in getting the most for his dollar and is constantly trying to get good quality lean meat, but the present marketing system does not encourage the farmer to produce what the consumer wants. Hence, the entire industry is not geared to give the consumer what is desired, or to compensate the farmer properly for producing what the consumer desires.

Why Has the Present System been Continued?

1. It has been accepted by the meat industry as a whole.
2. Until recent years, little emphasis was placed upon the individual differences in the cut-out performance of hog carcasses.
3. Emphasis has been on dressing percentage rather than on cut-out performance.
4. Packers have been reluctant to accept any complete change in the marketing system because of the cost involved and the lack of research information.
5. World War II delayed experimentation and education in the meat industry.
6. Hog producers have been little concerned about the actual value of hog carcasses based on products sold, because research upon this aspect of marketing hasn't been available to the producer.
7. Research on this subject has been limited, and funds for carrying on research work were limited until the passage of the Research and Marketing Act in 1946.

SECTION III — PROCEDURES
METHOD OF COLLECTING DATA

The North Central Livestock Marketing Research Committee prepared certain procedures which each state was to follow as closely as possible in order to make the data comparable from all cooperating states.

Weights

To make an analysis of carcasses from live hogs weighing from 180 to 300 pounds, it was necessary to select carcasses weighing from 115 to 215 pounds. At least ten consecutive ten-pound weight ranges were selected by the committee for the analysis. Ohio extended the lower and upper limits of this range and selected 13 ten-pound weight ranges for its analysis.

Types

Within each weight group it was important also to sample the entire range of physical variation in finish, regardless of the numbers

in which these physical categories came to market. The purpose of such classification was to insure a sample of carcasses having a wide and uniform distribution of degree of finish within each weight group. The main difficulty was to obtain adequate numbers of light weight, very fat carcasses, and it was almost impossible to obtain enough heavy weight, very lean carcasses.

Actual Selection

Test hogs were kept separate from other hogs, slaughtered separately, and moved to a cooler equipped suitably for handling, measuring and weighing carcasses.

Carcasses with damaged shackle bruises, ham, loin, or belly bruising or with jowls trimmed noticeably for diseased glands, were discarded if the amount trimmed off was enough to effect materially the weight of the individual wholesale cuts.

Weighing and Measuring

The carcasses were weighed in the cooler the day following slaughter and the chilled weight recorded. After slaughter the carcasses remained in the coolers for 48 hours before being cut into individual wholesale pork cuts.

The carcasses were measured according to standard procedures set forth by the Regional Research Committee for body length, backfat thickness, ham length, hind leg length, ham width, shoulder width, and body depth as shown in the Appendix. To facilitate calculation in the analysis all measurements were taken in millimeters.[1]

Definition of Terms

Yield: Indicates the individual weights of the wholesale pork cuts expressed as a percentage of carcass weight.

Cut-Out Performance: Indicates the total weights of the individual wholesale pork cuts expressed as a percentage of carcass weight.

Cut-Out Value: Indicates the value of the total weight of the individual wholesale pork cuts from a carcass.

Carcass Weight: Indicates the weight of the carcass as it hangs on the rail in the slaughtering plant with head removed, leaf fat removed, with the jowls on, kidneys out, and ham facings off.

Dressing Percentages: The weight of the carcass expressed as a percentage of live weight.

Carcass Weight and Approximate Equivalent Live Weight:

115-135 pounds	170-195 pounds
135-155 pounds	195-220 pounds
155-175 pounds	220-250 pounds

Butts and Picnics: The two component parts of the New York style shoulder trimmed to the specifications of the packing plant concerned.

Measurements: For measurements used refer to Appendix.

Cutting Procedure: For cutting procedure used refer to Appendix.

[1]One inch = 25.39876 millimeters.

SECTION IV — GRADES[1]

COMPARISON OF CARCASS GRADES

In order to compare the differences in carcass grades of hogs, a meat grading specialist of the Production and Marketing Administration, United States Department of Agriculture and Lawrence E. Kunkle of the Ohio Agricultural Experiment Station graded each hog carcass. The federal grader placed grades on each carcass according to the standards established by the United States Department of Agriculture, while Mr. Kunkle used his own standards with primary emphasis upon quality features.

Under the standards established by the United States Department of Agriculture the grades placed upon a given carcass depended primarily on the conformation, finish, and quality of the carcass.

> "With respect to conformation the most desired carcass is straight and even in its lines, wide in proportion to its length, well developed in the back, loin, sides, and hams, well developed but free from heaviness or coarseness in shoulders and neck, smooth throughout, and free from prominence on the underline. The degree of fatness usually referred to as finish is shown by the depth of fat along the back by the quantity of leaf fat, and by a plump, full appearance throughout, and by a good width of back and side in proportion to the length of body. A carcass is supposed to have quality when it is smooth, fine in head and shanks, fine in texture of flesh, bright in color of lean, and white in color of fat. Creases, staggy necks and shoulders and seedy bellies indicate coarseness.
>
> "An example showing the application of these standards would be a carcass with conformation and quality satisfactory for a No. 1 grade. However, the finish on fat may be soft, and therefore the carcass would be given a No. 2 grade because soft carcasses tend to have a higher shrink and yield cuts of poorer shape."[1]

The standards used by Mr. Kunkle differed from the federal grader's in that a score sheet which included cut-out value as well as the so-called "Pork Quality Features" was established. In combining both of these factors Mr. Kunkle hoped to establish grades which would give the high quality desired by consumers and also indicate the more valuable carcasses. This combination of most desirable features would rank the grades in this order: Choice Meat, Good Meat, Good Fat, Choice Fat, and Medium.

Tables 1 and 2 compare the results of grading according to the United States Department of Agriculture standards with the same carcasses graded by Mr. Kunkle of the Ohio Agricultural Experiment Station.

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[1]Op. cit. page 17.

[1]Lehmkuhl, Robert L., "Some Factors Affecting Hog Carcass Value," The Ohio State University, Thesis, June, 1950, Section III. For more detail the reader is invited to refer to this thesis.

Table 1 — Comparison of United States Department of Agriculture Carcass Grades with the Ohio Agricultural Experiment Station Carcass Grades on 508[1] Hog Carcasses

Grades Ohio Experiment Station	Grades United States Department of Agriculture						Total	
	No. 1 Meat	No. 1 Fat	No. 2 Meat	No. 2 Fat	No. 3 Meat	No. 3 Fat	Number	Percent
	Number of Carcasses							
Choice Meat	28	11	54	26	1	0	120	23.6
Choice Fat	13	80	6	37	0	0	136	26.8
Good Meat	6	5	76	30	10	3	130	25.6
Good Fat	8	24	8	32	0	1	83	16.3
Medium to Good (Meat Type)	0	0	18	1	18	0	37	7.3
Cull	0	0	0	0	1	0	1	0.2
Sow	0	0	0	0	0	1	1	0.2
Total	55	120	162	136	30	5	508	100.0
Percent	10.8	23 6	31.9	26.8	5.9	1.0	100.0	

[1]One lot, consisting of 32 hogs not included because only one agency graded them.

Table 3 — Percentage Distribution of Ham, Loin, and Belly Grades by Carcass Grade (As graded by a representative of the U.S.D.A.)

Carcass Grade	Number of Carcasses	Percentage of Total Carcasses	Ham Grades			Loin Grades			Belly Grades		
			No 1	No 2	No. 3	No 1	No. 2	No. 3	No. 1	No. 2	No. 3
			(percent)								
No. 1 Meat	57	10.6	78.9	21.1	-	93.0	7.0	- -	75.4	24.6	
No. 1 Fat	130	24.1	74.6	25.4	-	77.7	22.3	----	89.2	10.8	
No. 2 Meat	172	31.9	2.9	91.3	5.8	4.1	91.9	4.0	5.8	67.5	26.7
No. 2 Fat	140	26.0	6.4	92.9	0.7	7.9	91.4	0.7	17.1	80.0	2.9
No. 3 Meat	35	6.5		8.6	91.4		42.9	57.1		5.7	94.3
No. 3 Fat	5	0.9		20.0	80.0		60.0	40.0		20.0	80.0
All Carcasses	539	100.0	28.9	62.4	8.7	31.9	62.7	5.4	35.8	48.1	16.1

Table 2
Comparison of United States Department of Agriculture Grades with the Ohio Agricultural Experiment Station Carcass Grades on 508 Hog Carcasses

United States Department of Agriculture			Ohio Agricultural Experiment Station		
Grades	Number	Percent	Grades	Number	Percent
No. 1 Meat	55	10.8	Choice Meat	120	23.6
No. 1 Fat	120	23.6	Choice Fat	136	26.8
No. 2 Meat	162	31.9	Good Meat	130	25.6
No. 2 Fat	136	26.8	Good Fat	83	16.3
No. 3 Meat	30	5.9	Medium to Good	37	7.3
No. 3 Fat	5	1.0	Cull	1	0.2
			Sow	1	0.2
Total	508	100.0		508	100.0

Examination of these tables show that the Ohio Agricultural Experiment Station grader placed more carcasses in the upper grades, while the federal grader placed the majority of the carcasses in the No. 2 grades. There was little disagreement in the number of hogs placed in the No. 3 and medium grades. It appears that there was some difference between the two graders as to which carcasses were meat type and which were fat type. For example, of the 136 carcasses graded as choice fat by the Experiment Station representative, 117 or 86.0 percent of the carcasses were graded as fat by the United States Department of Agriculture grader. Of 287 meat type carcasses graded by the Experiment Station representative, 211 or 73.5 percent were classified also as meat type by the federal grader. The Experiment Station representative graded 56.5 percent of all carcasses as meat type, while the federal grader considered 48.6 percent of all carcasses as meat type.

GRADES OF INDIVIDUAL WHOLESALE PORK CUTS

Did the grade of the individual wholesale cuts of pork correspond to the grade placed on the entire hog carcass as it was hanging on the rail in the packing plant? This question may be answered at least partially by the data collected during the course of this study. The most valid comparison can be made by comparing the carcass grade with the grade placed on each individual cut. The grades used were those established by the United States Department of Agriculture, because the packing company grades were obtained only on the individual cuts and not on the entire carcass.

Table 3, based on the grades of a federal representative, gives the percentage distribution of ham, loin, and belly grades for each carcass grade. For example, of the 172 carcasses graded as No. 2 meat, 91.3 percent of the hams, 91.9 percent of the loins, and 67.5 percent of the bellies were also No. 2 grades. This table shows that approximately one-fourth of the No. 1 and No. 2 meat carcasses produced bellies which graded lower that the carcass as a whole. The No. 1 fat carcasses produced a much higher percentage of No. 2 loins than did the No. 1 meat carcasses.

The No. 1 meat and No. 1 fat carcasses made up 34.7 percent of all carcasses, while 28.9 percent of the hams, 31.9 percent of the loins, and 35.8 percent of the bellies were graded as No. 1. From these data, one must conclude that on the whole the carcass grades tended to carry through to corresponding loin grades more regularly than in the case of hams, and the belly grades appeared to vary most frequently from the grades placed on the entire carcass.

The grades of individual cuts may vary from the carcass grade for many reasons. First, the carcass grade is determined by a combination and evaluation of many factors of the carcass as a whole. The individual cut may be a low quality, but the other features of the carcass may be desirable enough to warrant a given grade. The firmness and amount of finish, the texture, color of the meat, bruises and other characteristics are some factors which might account for an individual cut receiving a grade, which does not correspond to the carcass grade.

Little information is available concerning standards and practices used by various packing companies in grading individual pork cuts. Graders employed by Armour and Company graded the hams, loins, and bellies of each carcass in this study.

Approximately 60 percent of the hams received the No. 1 or the Star grade, while slightly over 15 percent were graded as A-special or the No. 2 grade. Twelve other grades accounted for the remaining hams. The loins were graded largely on the basis of weight and nearly 50 percent of all loins fell into the 8-12 pound (A) grade. Another 43.5 percent of the loins received the 12-16 pound (B) grade, while the remaining loins were scattered into six other grades. Of the bellies, 34.4 percent were graded as Star, the top grade, approximately 27 percent as Slicer, the next highest grade, and more than 26 percent as Melrose, the third highest grade. Eight other grades accounted for the bellies not included by these three major grades.

Star hams were obtained from carcasses of all weight groups. However, the hams graded as A-Special tended to be concentrated in carcasses weighing from 115 to 165 pounds. Since the company grade of loins was based largely on weight, one would expect the 8-12 pound (A) loins to come from lighter weight carcasses and the 12-16 pound (B) loins from heavier carcasses.

Carcasses weighing 155-175 pounds showed a tendency to cut-out in about an equal number of 8-12 pound and 12-16 pound loins .There was also a certain amount of overlapping in the other weight groups, which would indicate that there was considerable difference in the weight of loin present in carcasses of the same weight.

Star bellies were found most frequently in carcasses weighing 125-145 pounds, but were distributed also throughout most of the other weight groups. Slicer bellies were distributed throughout all of the weight groups, however, as carcass weight increased, the percentage of slicer bellies decreased. Melrose bellies were found in all carcass weight groups, but were concentrated in carcasses weighing

175 pounds and over. The weight of the belly was the primary factor which determined whether it was graded Melrose.

SECTION V — CARCASS VALUE
VALUE AS APPLIED TO PRESENT GRADES

In order to show which set of carcass grade standards was the most accurate in grading the carcasses as far as cut-out value is concerned, Tables 4 and 5 are presented. The cut-out values of the carcasses included in these two tables ranged from $22.01 to $27.81 per hundred pounds of carcass weight. Values were calculated on a hundred-weight basis to permit the comparison of carcasses of different weights. The wholesale prices of pork cuts and trimmings for November and December, 1949, were used as the basis for computing the cut-out value.

It is evident that the lighter weight carcasses have the highest cut-out value and that value tends to decrease as carcass weight increases. This may be explained easily because as carcass weight increases the percentage of fat and lower priced cuts increase. The heavier carcasses also produce larger and heavier cuts which sell for lower prices because of the limited demand for fat cuts of pork by consumers.

In most instances, the meat type carcasses were of higher value on the average than the fat type carcasses. The differences in value were small in some cases, but amounted to 50 or 60 cents per hundred-weight in others, particularly in the carcass weights below 155 pounds.

According to the standards used by the Ohio Agricultural Experiment Station representative, the carcasses graded as medium were highest in value. The good meat carcasses were next, followed by choice meat, good fat, and choice fat. The rank of grades used by the United States Department of Agriculture representative in order of the cut-out value of carcasses was No. 3 meat, No. 2 meat, No. 1 meat; No. 2 fat and No. 1 fat. The No. 3 fat carcasses were not rated because there were too few carcasses in this grade.

Carcasses graded as choice by the Experiment Station representative averaged slightly higher in value than did the No. 1 federal graded carcasses. However, carcasses graded No. 2 by federal standards averaged higher in value than did the carcasses graded as good by the Station representative.

In the Ohio Station representative's grades, the medium carcasses were consistently higher in value in most cases than the average of all carcasses. Sixty-two percent of the good meat carcasses and 41 percent of the choice meat carcasses were higher than average in value. Only 39 percent of the good fat and 37 percent of the choice fat carcasses were above average value.

In heavier weight groups, the good and choice meat carcasses were usually higher than average value, while choice and good fat carcasses were generally lower than average value in lighter weight groups.

Table 4

Average Value of Carcasses by Weight Groups as Graded by a Representative of the Ohio Agricultural Experiment Station

(Dollars per hundredweight of carcass)

Weight Group (pounds)	Average Value All Carcasses	Choice Meat	Choice Fat	Good Meat	Good Fat	Medium
105-115	$26.11(22)[1]	$25.53(4)	$25.64(1)	$25.95(7)	----------	$26.81(5)
115-125	25.84(43)	25.50(8)	25.26(4)	25.74(17)	$25.65(3)	26.44(8)
125-135	25.37(50)	25.22(10)	25.09(9)	25.53(12)	24.67(7)	26.18(9)
135-145	24.78(51)	24.99(8)	24.37(15)	25.13(12)	24.40(10)	25.53(4)
145-155	24.69(40)	24.80(12)	24.14(4)	24.86(15)	23.89(3)	25.12(3)
155-165	24.29(34)	24.35(14)	24.14(7)	24.39(5)	24.04(5)	----------
165-175	23.74(37)	23.96(10)	23.69(11)	24.04(5)	23.45(6)	----------
175-185	23.75(51)	23.93(14)	23.40(12)	24.20(5)	23.51(11)	----------
185-195	23.57(39)	23.98(9)	23.23(18)	23.94(4)	23.57(7)	24.31(1)
195-205	23.33(46)	23.78(7)	23.17(17)	23.63(8)	23.08(11)	----------
205-215	23.60(40)	23.92(7)	23.31(11)	23.75(11)	23.45(8)	----------
Weighted Average	24.41(453)	24.48(103)	23.79(109)	24.84(101)	23.82(71)	26.10(30)

[1]Figures in parenthesis indicate the number of carcasses included in average. Only 414 carcasses were included in the breakdown of averages by grades because some carcasses were not graded and minor grades were not included.

Table 5

Average Value of Carcasses by Weight Groups as Graded by a Representative of The United States Department of Agriculture

(Dollars per hundredweight of carcass)

Weight Group (pounds)	Average Value of all Carcasses	No. 1 Meat	No. 1 Fat	No. 2 Meat	No. 2 Fat	No. 3 Meat	No. 3 Fat
105-115	$26.11(22)[1]	$25.64(2)	.....	$25.81(10)	$25.64(1)	$26.61(9)	.....
115-125	25.84(43)	25.40(5)	$25.18(1)	25.72(22)	25.58(2)	26.31(13)	.....
125-135	25.37(50)	25.07(5)	25.03(8)	25.66(25)	24.91(10)	26.16(2)	.....
135-145	24.78(51)	24.33(3)	24.35(15)	25.15(19)	24.59(11)	25.67(3)	.....
145-155	24.69(40)	24.48(5)	23.64(2)	24.81(25)	24.19(4)	25.36(2)	$25.12(2)
155-165	24.29(34)	24.36(9)	24.52(2)	24.36(16)	23.77(6)	24.91(1)	.....
165-175	23.74(37)	24.00(8)	23.53(13)	23.79(7)	23.76(9)	.....	.....
175-185	23.75(51)	24.00(9)	23.31(14)	24.03(10)	23.63(15)	24.87(2)	24.43(1)
185-195	23.57(39)	23.76(2)	23.39(16)	24.03(5)	23.57(16)	.....	.....
195-205	23.33(46)	23.50(1)	23.09(21)	23.64(5)	23.50(18)	.....	23.51(1)
205-215	23.60(40)	23.04(1)	23.31(12)	23.74(5)	23.75(22)	.....	.....
Weighted Average	24.41(453)	24.41(50)	23.63(104)	24.95(149)	23.92(114)	26.13(32)	24.54(4)

[1]Figures in parenthesis indicate number of carcasses included in each average.

In federal grades, 75 percent of the No. 3 meat carcasses were above average in value, while only 51 percent of the No. 2 meat and 34 percent of the No. 1 meat carcasses were higher than average value. Twenty-five percent of the carcasses graded as No. 2 fat and 27 percent of the carcasses graded as No. 1 fat were above the average value for all carcasses in their weight group. Most of the carcasses graded as No. 2 meat and above average in value were found in the 105-145 pound weight group.

On the basis of the results it would seem that none of the grades were sufficiently accurate to determine high or low valued carcasses under their respective grade standards used.

EFFECT OF THE PRIMAL CUTS (HAMS, LOINS, PICNICS, BUTTS, AND BELLIES) ON CARCASS VALUE

In order to properly analyze and appraise the value of a hog carcass, it is necessary to consider the more important component parts. Five wholesale cuts known as the primal cuts contribute from 80.0 to 85.0 percent of the total carcass value of a hog per hundredweight. Bellies are important in determining the value of a carcass, but they have a negative influence when related to the physical factors, thickness of backfat, hind leg length, and body length. Hence, with the omission of bellies the four remaining factors are referred to commonly as the four lean cuts. These four lean cuts are in close relationship to the important physical factors and comprise from 65 to 70 percent of the total carcass value per hundredweight. The average dollar value by weight groups for the four lean cuts and five primal cuts is shown in Table 6.

As was pointed out previously, the average total dollar value per hundred pounds of carcass decreased as the weight of the carcass increased. An exception to this generalization appears in the carcasses weighing over 205 pounds when the average value was higher compared to the average value in the 195-205 pound weight group.

It is evident from this table that hams contributed a larger proportion of the total carcass value than any of the other individual cuts. Loins, followed by bellies, were the next two most important cuts in value per hundred pounds of carcass. Picnics were slightly lower than the butts in dollar value. As average total carcass value declined, the average value of the individual cuts tended to decline also as a general rule.

VALUE APPLIED TO INDIVIDUAL WHOLESALE CUTS

In order to show the value of a hog carcass and the percentage variation of individual cuts which exists among carcasses of approximately the same weight, Tables 7 and 8 are presented. Table 7 shows the range in the percentage yield of hog carcasses for four selected weight groups based on the highest value and the lowest value carcass in each weight group.

Examination of the five primal cuts reveals that the bellies showed the greatest variation between the high and low valued

Table 6

Average Total Carcass Value, and Average Value of Skinned Hams, Loins, Picnics, Boston Butts, and Bellies for 477 Hog Carcasses by Weight Groups

(In dollars per hundred pounds of carcass)

Weight Group (pounds)	Number Carcasses	Average Carcass Value	Skinned Hams	Loins	Bellies	Boston Butts	Picnics	Total Five Cuts	Percent Total Value	Percent of Four Lean Cuts of Total Value
105-115	22	$26.11	$7.93	$5.40	$4.16	$2.44	$2.39	$22.32	85.5	69.6
115-125	43	25.84	7.76	5.51	4.06	2.33	2.32	21.98	85.1	69.3
125-135	50	25.37	7.45	5.28	4.10	2.25	2.22	21.30	84.0	67.8
135-145	51	24.78	7.15	5.11	4.12	2.14	2.18	20.70	83.5	66.9
145-155	40	24.69	7.16	5.20	4.04	2.26	2.19	20.85	84.4	68.1
155-165	34	24.29	6.87	5.15	3.94	2.26	2.08	20.30	83.6	67.4
165-175	37	23.74	6.63	4.90	3.92	2.12	2.07	19.64	82.7	66.2
175-185	51	23.75	6.60	4.93	3.82	2.21	2.06	19.62	82.6	66.5
185-195	39	23.57	6.50	4.98	3.72	2.11	2.01	19.32	82.0	66.2
195-205	46	23.33	6.48	4.77	3.72	2.13	1.96	19.06	81.7	65.8
205-215	40	23.60	6.66	4.90	3.58	2.18	2.01	19.33	81.9	66.7
215-225	11	23.36	6.49	4.74	3.74	2.17	2.02	19.16	82.0	66.0
225-up	13	23.32	6.41	4.80	3.52	2.08	1.95	18.76	80.4	65.4

carcasses for four weight groups. Fatbacks and fat trimmings also showed wide variation in value.

The application of the November-December, 1949, wholesale prices at Chicago to these wholesale cuts on a per hundredweight basis for the same hog carcasses is shown in Table 8. The variation in percentage yield as shown in the previous table is expressed clearly when values are applied. A hog carcass having a small amount of fatback and fat trim has a greater percentage of its carcass weight in the five primal cuts; thus, this type of carcass has a greater value on a per hundredweight basis. This table shows also that the lighter weight carcasses are worth more per hundredweight than the heavier weight carcasses. This is shown in the table where the highest valued carcass in the 115-135 pound weight group was worth $27.08 per hundredweight, while the highest valued carcass in the 175-195 pound weight group was worth only $25.39.

Table 9 compares the per hundredweight value of the wholesale cuts for two selected hog carcasses of approximately the same weight using varying levels of prices at Chicago. Although the values per individual cuts varied with the price standard used, the total carcass value per hundredweight for the 116.0 pound carcass was greater in all cases than the 116.2 pound carcass, even though the differential among the total values widened and narrowed for the prices prevailing during 1948 to 1950.

Table 7

Comparison of the Per Hundredweight High and Low Value Hog Carcasses on the Basis of Their Percentage Yield for Four Selected Weight Groups

(Expressed as a percentage of carcass weight)

Wholesale Cut	115-135		135-155		155-175		175-195	
	Highest Carcass	Lowest Carcass	Highest Carcass	Lowest Carcass	Highest Carcass	Lowest Carcass	Highest Carcass	Lowest Carcass
	(percent)							
Hams	25.4	22.1	29.1	24.3	29.8	28.1	38.5	29.5
Loins	19.3	15.6	23.6	19.1	25.0	21.7	27.7	24.1
Bellies	14.4	22.4	21.1	28.1	24.8	33.8	22.6	36.2
Picnics	12.5	11.8	13.3	12.9	14.4	16.3	18.0	16.5
Butts	9.4	8.0	11.3	9.8	12.1	10.6	13.8	12.8
Fat and Lean Trim and Seedy Belly	7.2	18.3	11.6	18.7	16.1	22.8	23.9	25.1
Regular and Belly Trim	5.6	2.3	6.1	5.6	2.6	2.9	8.9	4.0
Fatback	5.2	18.9	8.3	15.2	16.0	20.8	12.9	24.2
Tail and Feet	5.1	3.4	4.9	3.6	4.1	4.3	5.9	3.8
Spareribs	4.9	2.4	4.4	3.6	3.6	3.6	5.3	3.5
Jowls	3.6	7.2	5.3	7.2	5.4	7.0	0.0	10.0
Neckbones	2.8	1.7	2.6	2.1	2.6	2.1	3.4	2.9
Lean Trim	0.7	0.3	0.7	0.2	0.6	0.4	1.9	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Carcass Weight	116.0	134.4	142.3	150.4	157.1	174.4	182.8	193.0

This is verified further in Table 10 which compares the two highest valued hog carcasses and the two lowest valued carcasses on a per hundredweight basis for selected weight groups at different price periods. Regardless of the price standard used, the relative position of the hog carcasses for the most part remained unchanged. One example of a shift occurred in the position of carcasses A and B in the 175-195 pound weight group. Carcass B was worth more than carcass A under the November-December 1949 and 1950, price standards, while carcass A was worth more under the other four price standards.

One general conclusion which can be made is the fact that regardless of the price standard used, hog carcasses will tend to hold their relative positions in most cases. Generally, this means that if a carcass is of higher value when the prices of pork are high, it will be of higher value when the prices of pork are low on the basis of the price of lard for recent years.

RELATIONSHIP OF BACKFAT THICKNESS, BODY LENGTH, AND HIND LEG LENGTH TO CARCASS VALUE

Since the percent of four lean cuts is responsible for 65.0 to almost 70.0 percent of the total carcass value of a hog per hundred-

Table 8

Comparison of the Per Hundredweight High and Low Value Hog Carcasses on the Basis of Total Carcass Value Per Hundredweight for Four Selected Carcass Weight Groups

Wholesale Cut	November-December, 1949, Value Per Hundredweight							
	115-135		135-155		155-175		175-195	
	Highest Valued Carcass	Lowest Valued Carcass	Highest Valued Carcass	Lowest Valued Carcass	Highest Valued Carcass	Lowest Valued Carcass	Highest Valued Carcass	Lowest Valued Carcass
Hams	$8.55	$6.79	$7.78	$6.31	$7.22	$6.13	$7.96	$5.81
Loins	5.86	4.08	5.84	4.47	5.52	4.38	5.25	4.36
Bellies	3.64	4.49	3.99	4.34	4.01	4.24	3.33	4.08
Picnics	2.54	2.06	2.14	1.96	2.09	2.10	2.18	1.93
Butts	2.48	1.82	2.44	2.00	2.36	1.86	2.31	2.04
Fat and Lean Trim and Seedy Belly	0.49	1.08	0.65	0.99	0.81	1.04	1.04	1.04
Regular-Belly Trim	0.82	0.29	0.73	0.63	0.28	0.28	0.83	0.35
Fatback	0.35	1.85	0.49	1.20	1.32	1.57	0.79	1.65
Tail and Feet	0.29	0.17	0.23	0.16	0.18	0.17	0.22	0.13
Spareribs	1.36	0.57	1.00	0.77	0.74	0.67	0.94	0.59
Jowls	0.26	0.45	0.32	0.41	0.29	0.34	0.00	0.44
Neckbone	0.22	0.11	0.16	0.13	0.15	0.11	0.16	0.13
Lean Trim	0.22	0.08	0.18	0.05	0.13	0.08	0.37	0.07
Total Carcass Value Per Hundredweight	27.08	23.87	25.94	23.42	25.11	22.96	25.39	22.63
Carcass Weight	116.0	134.4	142.3	150.4	157.1	174.4	182.8	193.0

Table 9

Comparison of the Values Per Hundredweight of the Wholesale Cuts for Two Selected Hog Carcasses of Approximately the Same Weight Using Varying Levels of Prices at Chicago

Wholesale Cut	Carcass No. 1							Carcass No. 2					
	Percent of Carcass Weight	November-December Value Per Hundredweight			1948 Value	1949 Value	1950 Value	Percent of Carcass Weight	November-December Value Per Hundredweight			1948 Value	1949 Value	1950 Value
		1948	1949	1950					1948	1949	1950			
Hams	25.4	$10.59	$8.55	$9.84	$11.28	$10.02	$9.78	25.4	$10.58	$8.54	$9.82	$11.26	$10.00	$9.77
Loins	19.3	7.00	5.86	6.56	8.90	7.83	7.56	19.2	6.96	5.82	6.52	8.83	7.77	7.51
Bellies	14.4	4.81	3.64	3.91	5.33	4.17	3.88	15.7	5.22	3.95	4.25	5.79	4.55	4.24
Picnics	12.5	3.30	2.54	3.18	3.93	3.17	3.15	11.0	2.89	2.23	2.79	3.45	2.78	2.76
Butts	9.4	3.25	2.48	3.03	3.69	3.14	3.14	10.4	3.59	2.75	3.35	4.07	3.47	3.47
Fat and Lean Trim and Seedy Belly	7.2	0.89	0.49	0.76	1.05	0.59	0.63	7.9	0.97	0.54	0.83	1.15	0.65	0.70
Regular and Belly Trim	5.6	1.10	0.82	1.06	1.35	0.99	1.04	4.9	0.96	0.71	0.93	1.19	0.86	0.91
Fatback	5.2	0.65	0.35	0.54	0.76	0.43	0.46	5.6	0.69	0.39	0.59	0.82	0.46	0.49
Tail & Feet	5.1	0.41	0.29	0.33	0.46	0.33	0.33	4.4	0.35	0.26	0.28	0.40	0.28	0.28
Spareribs	4.9	1.71	1.36	1.53	1.80	1.60	1.58	3.8	1.33	1.06	1.18	1.39	1.24	1.22
Jowls	3.6	0.48	0.26	0.39	0.62	0.35	0.39	4.4	0.59	0.32	0.47	0.76	0.43	0.47
Neckbones	2.8	0.41	0.22	0.24	0.37	0.28	0.28	2.9	0.41	0.22	0.25	0.38	0.29	0.28
Lean Trim	0.7	0.24	0.22	0.26	0.28	0.24	0.25	0.6	0.21	0.18	0.22	0.23	0.21	0.22
Total Carcass Value Per Hundredweight	100.0	34.84	27.08	31.63	39.82	33.16	32.47	100.0	34.75	26.97	31.48	39.72	32.99	32.32
Carcass Weight	116.0	.....	.....	.....	.....	.....	.....	116.2	.....	.....				

weight, the factors which cause variation in the percentage yield of the four lean cuts should show a close relationship also to the carcass value of a hog on a per hundredweight basis. In order to determine this relationship, a multiple correlation was developed showing the effects of these factors upon total carcass value per hundredweight[1] for one weight group. Table 11 shows these relationships for the 115 to 135 pound weight group where X_1 = value, X_2 = backfat thickness, X_3 = body length, and X_4 = hind leg length.

These results indicate that hind leg length (r14) added more to the explained variation in total carcass value than did body length (r13). For this weight group, backfat thickness and hind leg length (R1.24) accounted for 63.6 percent of the variation in total carcass value per hundredweight, and the addition of body length (R1.234) added only 0.1 percent to this result. The combined effect of all three variables accounted for 63.7 percent of the variation in total carcass value per hundredweight for this weight group, indicating

[1]Value based on the November-December, 1949, wholesale prices of pork cuts at Chicago.

Table 10

Comparison of the Two Highest Value and the Two Lowest Value Hog Carcasses Per Hundredweight at Different Price Periods for Selected Weight Groups

Carcass Weight Groups		November-December Value Per Hundredweight			Value	Value	Value
		1948	1949	1950	1948	1949	1950
115-135							
Highest	(A	$34.84	$27.08	$31.63	$39.82	$33.16	$32.47
Value	(B	34.75	26.97	31.48	39.72	32.99	32.32
Lowest	(Y	32.17	24.27	28.24	36.24	28.83	28.36
Value	(Z	31.70	23.87	27.83	35.71	28.22	27.85
135-155							
Highest	(A	34.01	25.94	30.47	39.09	32.04	31.43
Value	(B	33.87	25.89	30.57	38.67	31.86	31.37
Lowest	(Y	31.66	23.42	27.81	35.96	28.65	28.25
Value	(Z	31.49	23.54	27.59	35.66	28.28	27.93
155-175							
Highest	(A	33.17	25.11	29.61	37.61	30.72	30.31
Value	(B	33.11	25.03	29.57	37.49	30.46	30.08
Lowest	(Y	31.38	23.23	27.67	35.66	26.95	28.03
Value	(Z	31.01	22.96	27.25	34.97	26.50	27.55
175-195							
Highest	(A	32.95	25.02	29.62	37.06	30.71	30.40
Value	(B	32.88	25.39	29.74	36.79	30.50	30.22
Lowest	(Y	30.52	22.63	26.87	34.27	25.84	27.05
Value	(Z	30.57	22.59	26.85	34.46	25.54	27.02

Table 11

The Relationship of Total Carcass Value Per Hundredweight to Various Selected Physical Factors (For 73 Carcasses)

Measure	Coefficient of Correlation	Coefficient of Determination
	(r)	(r^2x100)
R1.234	0.7979	63.7%
R1.24	0.7976	63.6
R1.23	0.7703	59.3
R1.34	0.6951	48.3
r12	0.7621	58.1
r13	0.5329	28.4
r14	0.6938	48.1

that there is a close relationship between the factors causing variation in the percentage yield of the four lean cuts and total carcass value. The same conclusion applies also to the other weight groups with slight differences in the stated percentages of explained variation.

SECTION VI — COMPARISON OF BACKFAT THICKNESS AT SEVENTH RIB AND THE AVERAGE OF THREE MEASUREMENTS

Does the measurement of backfat thickness of the hog carcass at the seventh rib give the same results as an average of three backfat readings made opposite the first rib, the last rib, and the last lumbar vertebrae? Analysis of 315 hog carcasses revealed the variation as shown in the following table.

It is evident that the backfat thickness at the seventh rib does not correspond accurately with the results obtained when the three measurements are averaged. Over 53.0 percent of the carcasses in

Table 12

Variation in Backfat Thickness Measured at the Seventh Rib from the Average of Three Measurements made Opposite the First Rib, Last Rib, and Last Lumbar Vertebrae (For 315 Carcasses)

Amount of Variation	Percent of Total Carcasses
Plus or minus 10 or more mm[1]	2.5%
Plus or minus 9 mm	1.6
Plus or minus 8 mm	4.5
Plus or minus 7 mm	5.1
Plus or minus 6 mm	7.0
Plus or minus 5 mm	7.0
Plus or minus 4 mm	8.9
Plus or minus 3 mm	16.8
Plus or minus 2 mm	19.7
Plus or minus 1 mm	19.0
No variation	7.9
Total	100.0

[1] 25.39876 mm = one inch.

this study had a backfat thickness at the seventh rib which varied three or more millimeters from the average of three measurements obtained for each carcass. Three millimeters is equal to 0.12 inches. In the proposed United States Department of Agriculture carcass grade standards published recently, a difference of 0.29 inches in average backfat thickness was equal to a change in the grade received by a carcass. Therefore, it would appear that a variation in backfat thickness of three millimeters or approximately 1/10 of an inch would be very significant. In addition, the effect of human errors in measurement of backfat thickness would be less important when three measurements are averaged, as compared to only one measurement in determining backfat thickness.

The backfat thickness at the seventh rib (independent variable) was correlated against the average of three backfat measurements resulting in a coefficient of correlation (r) of +0.93607 and a coefficient of determination (r^2x100) of 87.6 percent. The high correlation coefficient indicates a close association of the factors affecting both variables. The coefficient of determination means that 87.6 percent of the variation in the average of the three measurements might be due to differences in the seventh rib measurement.

This leaves 12.4 percent residual or unexplained variation not accounted for by differences in the seventh rib measurement; thus indicating that the seventh rib measurement doesn't explain adequately all of the variation that would be indicated by the average of the three measurements. Thus, it would seem that for most purposes backfat thickness should be indicated by an average of three measurements rather than one.

SECTION VII — SELECTION OF THE FACTORS WHICH INFLUENCE THE PERCENTAGE YIELD OF THE FOUR LEAN CUTS (HAMS, LOINS, PICNICS AND BUTTS)

Section V of this study has indicated that the four lean cuts determined from 65.0 to 70.0 percent of the total carcass value of a hog. The inclusion of the bellies would increase this percentage to a range of 80.0 to 85.0 percent, but since bellies are not classified commonly as a lean cut and adds little to the correlation coefficient, they have not been included.

Selection of the factors which influence the percentage yield of the four lean cuts was a most difficult problem, since so many factors may be involved. In the results of a similar study published recently by the University of Minnesota[1] the conclusion was inferred that backfat thickness was the primary determinant of carcass merit and that other factors did not improve the relationship enough to warrant their detailed treatment in correlation procedures. Results of the Ohio study have indicated that backfat thickness, hind leg length, and body length should be considered as important physical factors affecting the percentage yield of the four lean cuts.

To show the influence of various factors influencing the percentage yield of the four lean cuts, a number of combinations

expressed as simple correlations are shown in Table A2 in the Appendix. Two light weight groups of carcasses (125-135, 135-145) and two heavy weight groups of carcasses (175-185, 185-195) were used as indications of relationship. Correlations also of the entire sample of 374 hogs are shown. It should be remembered that differences between the coefficients of correlation of the entire sample and the individual weight groups were due primarily to the weight variable which was present in the total sample, and relatively insignificant in the individual weight groups.

Dealing with the physical measurements, average backfat thickness was the most important single physical factor. Other important physical factors related closely to the percent of four lean cuts were: hind leg length, body length, and ham length. For the total sample these measurements above revealed a very low relationship, but they become increasingly important in the individual weight groups.

Table 13 shows the coefficients of correlation and determination for some of the important physical factors. For the 374 hogs the coefficient of correlation of average backfat thickness associated with the percent of four lean cuts was -0.8179. This indicated that in this sample a close association of the factors were common to both variables and the determination coefficient indicated that average backfat thickness explained 66.9 percent of the variation in the percentage yield of the four lean cuts, assuming all other things equal.

On an individual weight group basis there seemed to be considerable variation in the coefficients of correlation between all of the individual measures and the percent of four lean cuts. There was a tendency for the coefficient of correlation to be higher in the light weight groups than in the heavy weight groups. The correlations of average backfat thickness ranged from a low of -0.4983 in the 185-195 pound weight group to a high of -0.9192 in the 225 and up pound weight group. Body length coefficients of correlation ranged from 0.2642 to 0.8092.

The coefficient of determination for body length was almost zero for the entire sample, yet when taken on an individual weight group basis body length accounted for a range of 7.0 percent to 65.5 percent of the variation in the percentage yield of the four lean cuts, all other things being equal.

MULTIPLE CORRELATION OF VARIOUS COMBINATONS OF FACTORS

(Three Variables)

Examination of Table A2 indicates that there might be many factors which explained partially the variation in the percentage yield of the four lean cuts. Various combinations of independent variables were selected by inspection and associated with the percent of four

[1]Engleman, Dowell, Ferrin, and Anderson, "Marketing Slaughter Hogs by Carcass Weight and Grade," University of Minnesota Agricultural Experiment Station Technical Bulletin 187, April, 1950.

Table 13

Relationships Between Percent of Four Lean Cuts (Hams, Loins, Picnics, Butts) and Average Backfat Thickness, Body Length, and Hind Leg Length by Specified Weight Groups

(For 374 Carcasses)

Carass Weight Group	Average Backfat Thickness			Body Length		Hind Leg Length	
	No. Carcasses	(r)	(r^2x100)	(r)	(r^2x100)	(r)	(r^2x100)
105-115	17	-0.7888	62.2%	0.6461	41.7%	0.6663	44.4%
115-125	35	-0.6911	47.8	0.4303	18.5	0.4866	23.7
125-135	38	-0.8534	72.8	0.8092	65.5	0.8283	68.6
135-145	39	-0.8842	78.2	0.5616	31.5	0.5957	35.5
145-155	31	-0.6877	47.3	0.5556	30.9	0.4887	23.9
155-165	25	-0.7233	52.3	0.2642	7.0	0.3765	14.2
165-175	30	-0.8103	65.7	0.6066	36.8	0.5060	25.6
175-185	41	-0.7917	62.7	0.7547	57.0	0.4689	22.0
185-195	33	-0.4983	24.8	0.3928	15.4	0.2966	8.8
195-205	35	-0.7030	49.4	0.5329	28.4	0.4966	24.7
205-215	31	-0.7063	49.9	0.4424	19.6	0.3108	9.7
215-225	10	-0.5954	35.5	0.2835	8.0	0.3261	10.6
225 and up	9	-0.9192	84.5	0.4373	19.1	0.3065	9.4
374 hogs		-0.8179	66.9	0.0558	0.3	0.3001	9.0

Table 14

Various Combinations of Relationships Between the Percent of Four Lean Cuts and Other Multiple Variables

(For 374 Carcasses)

Measure[1]	Combination A Coefficient of		Combination B Coefficient of		Combination C Coefficient of	
	Correlation (r)	Determination (r^2x100)	Correlation (r)	Determination (r^2x100)	Correlation (r)	Determination (r^2x100)
r12	-0.4591	21.08%	-0.8180	66.91%	0.2088	4.36%
r13	0.2383	5.68	0.0558	0.31	-0.5896	34.76
r14	-0.4463	19.92	0.3001	9.01	0.2938	8.63
R1.34	0.4646	21.58	0.3423	11.72	0.6761	45.71
R1.24	0.4644	21.57	0.8445	71.32	0.3744	14.02
R1.23	0.4768	22.73	0.8413	70.78	0.6317	39.91
R1.234	0.4806	23.10	0.8482	71.95	0.7222	52.16

[1] Combination A

X_1 = Percent of Four Lean Cuts
X_2 = Total Carcass Weight
X_3 = Percent of Lean Trim
X_4 = Total Ham Width

Combination B

X_1 = Percent of Four Lean Cuts
X_2 = Average Backfat Thickness
X_3 = Body Length
X_4 = Hind Leg Length

Combination C

X_1 = Percent of Four Lean Cuts
X_2 = Ham Length
X_3 = Percent of Bellies
X_4 = Total Shoulder Width

lean cuts as the dependent variable for the entire sample of 374 hogs. The results are shown in Table 14.

In an attempt to select the most important factors determining the variation in the percentage yield of he four lean cuts, Combination B stood out as being the most important. In this combination, backfat thickness as a single factor explained 66.9 percent of the variation in the percent of four lean cuts. The addition of hind leg length increased the percentage of explained variation by 4.4 percent and the further addition of body length increased the percentage of explained variation 0.6 percent; thus, the total variation explained by all three factors amounted to 71.9 percent.

Multiple Correlation
(Nine Variables)

The next question which arose was whether, and how much, the coefficient of correlation could be improved by additional factors.

The Statistical Laboratory in the Department of Mathematics, the Ohio State University, under the direction of Dr. D. R. Whitney helped work out this problem. The percent of four lean cuts was designated as the dependent variable, and nine independent variables were selected.

A multiple regression of X_1 on X_2, ..., X_{10} was required where the variables were as follows for 374 hogs.[1]

X_1 = Percent of Four Lean Cuts
X_2 = Average Backfat Thickness
X_3 = Body Length
X_4 = Hind Leg Length
X_5 = Total Carcass Weight
X_6 = Percent of Lean Trim
X_7 = Total Ham Width
X_8 = Ham Length
X_9 = Percent of Bellies
X_{10} = Percent of Fat Trim

The result indicated that the combined effect of the nine independent variables explained 94.5 percent of the variation in the percentage yield of the four lean cuts for the entire sample.

When the variables X_5 and X_6 were omitted, the new value of Se^2 (unexplained variation) was 224.677, so the change in the amount of unexplained variation was slight.

As it would be almost humanly impossible to estimate accurately in a live hog the nine factors listed above, the writers were faced with the problem of eliminating some of these factors and arriving at two or three important factors which would explain a substantial amount of the variation in the four lean cuts. Scales can be used to separate hogs into weight groups, therefore, this factor can be elimi-

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[1] $1 - \frac{Se^2}{Sy^2} = 1 - \frac{223.994}{4055.301} = 0.9721; r^2 = 0.945$

Se^2 = The sum of the squares of the deviation about the regression line, where
$Se^2 = Sy^2 - b \propto Sx \propto y$
$= 4055.301 - 3831.307$
$= 223.994$

(e) is the constant in a polynomial equation.

Sy^2 is the sum of the squares of the deviation about the four lean cuts.

nated. Percent of lean trim, fat trim, and bellies can be eliminated on the grounds that they are very hard to see and estimate in a live hog. Ham width has indicated very little relationship in both the simple and multiple correlation problems. Ham length can be eliminated (by definition) because it is related so closely to hind leg length.

Thus, three physical measurements remain (backfat thickness. hind leg length, body length) accounting for 71.9 percent of the variation in the percentage yield of the four lean cuts as indicated by Combination B in Table 14.

Before making a final decision as to the most important factors determining the variation in the percent of four lean cuts, one question still remained unanswered. How much would the addition of the fat cut, percentage yield of bellies, along with the three variables (backfat thickness, hind leg length, and body length) improve the estimate of the variation in the yield of the four lean cuts?

The results indicated that the addition of the percentage yield of bellies improved the total estimate by 3.3 percent. Since this factor was a component part of the carcass itself, and would be very hard to determine when applied to a live hog, the writers have decided to use only the three physical measurements (backfat thickness, hind leg length, and body length) as the most important physical factors determining the variation in the percentage yield of the four lean cuts. Therefore, the remainder of the discussion will be concerned with the four lean cuts and the three important physical factors.

It is the conviction of the writers that these three factors are responsible for most of the variation in value. If one hog is a dollar higher in value than another hog in the same weight group, the variation in these three physical factors will explain largely the differences in value. Body depth, another possible physical factor, added little to the coefficient correlation.

SECTION VIII — RELATIONSHIP OF THE THREE SELECTED PHYSICAL FACTORS (BACKFAT THICKNESS, BODY LENGTH, AND HIND LEG LENGTH) TO THE PERCENTAGE YIELD OF THE FOUR LEAN CUTS BY SPECIFIED WEIGHT GROUPS

Because the majority of butcher hogs are marketed under 250 pounds live weight, this part of the analysis is concerned with three weight groups of hogs as follows:

Carcass Weight	Live Weight Equivalent
115-135	170-195
135-155	195-220
155-175	220-250

The multiple regression of the three selected physical factors on the percent of four lean cuts is shown in Table 15 where X_1 = percent of four lean cuts, X_2 = average backfat thickness, X_3 = body length, and X_4 = hind leg length.

For all three weight groups backfat thickness was the most important single factor explaining variation in the percentage yield of

Table 15

The Relationship of the Percent of Four Lan Cuts to Various Selected Physical Factors by Specified Weight Groups

Measure[1]	Weight Groups					
	115-135		135-155		155-175	
	Coefficient of Correlation (r)	Coefficient of Determination (r^2 x 100)	Coefficient of Correlation (r)	Coefficient of Determination (r^2 x 100)	Coefficient of Correlation (r)	Coefficient of Determination (r^2 x 100)
R1.234	0.8539	72.9%	0.8701	75.7%	0.8018	64.3%
R1.23	0.8405	70.6	0.8686	75.5	0.7855	61.7
R1.24	0.8482	71.9	0.8507	73.4	0.8009	64.1
R1.34	0.7545	56.9	0.6801	46.3	0 5112	26.1
r12	-0.8115	65.9	-0.8418	70.9	-0.7818	61.1
r13	0.6482	42.0	0.6426	41.3	0.4102	16 8
r14	0.7360	54.2	0.6029	36.3	0.4259	18.1
Number of Carcasses	73		70		55	

[1] X_1 = Percent of Four Lean Cuts
X_2 = Average Backfat Thickness
X_3 = Body Length
X_4 = Hind Leg Length

four lean cuts. The addition of hind leg length increased the percentage of explained variation by 6 percentage points in the 115-135 pound weight group, 2.5 percent in the 135-155 pound weight group, and 3 percent in the 155-175 pound weight group. The addition of body length further increased the percentage of explained variation 1 percent in the 115-135 pound weight group, 2.3 percent in the 135-155 pound weight group, and 0.2 percent in the 155-175 pound weight group.

Thus, on the basis of this grouping, backfat thickness was the most important single factor in all three weight groups and hind leg length was the next most important factor in two out of the three weight groups. Only in the 135-155 pound weight group did body length appear more important than hind leg length. The writers believed that since hind leg length and body length contributed from 3.2 percent to 7.0 percent to the explained variation, these factors should be considered along with backfat thickness.

Chart 1 shows the highest estimating relationship in the 135-155 pound weight group than any of the other two groups when all three factors are concerned, but it shows also that the 155-175 pound weight group has the highest improvement by adding hind leg and body length, although the total estimation of this group is the lowest.

The Relationship Between the Percent of Four Lean Cuts and Backfat Thickness

Chart 2 shows the regression line describing the relationship between average backfat thickness and the percent of four lean cuts for five separate weight groups. Since there were no observations beyond the stated ranges for any weight group, the regression equation has little reliability beyond these points.

The equation for the 115-135 pound weigth group indicated that for every percentage decrease in percent of four lean cuts, there was a 1.7 millimeter (increase) change in backfat thickness. The regression line for the 175-205 pound weight group appears out of line with the regression lines of the other weight groups. As one moves from light weight carcasses to heavy weight carcasses, a percentage decrease in the percent of four lean cuts will bring an increasing change in average backfat thickness.

The line of means indicates that in this sample, as one moves from light weight hogs to heavy weight hogs, as average backfat thickness increases the percentage yield of the four lean cuts decreases at a decreasing rate. In other words, there is a tendency for a leveling off in percentage yield as one increases in backfat thickness moving from a light to a heavy weight group. Thus, backfat thickness appears to be more important in carcasses under 155 pounds.

The Relationship Between the Percent of Four Lean Cuts and Body Length

The relationship between body length and the percent of four lean cuts revealed an interesting pattern also as shown in Chart 3. Here

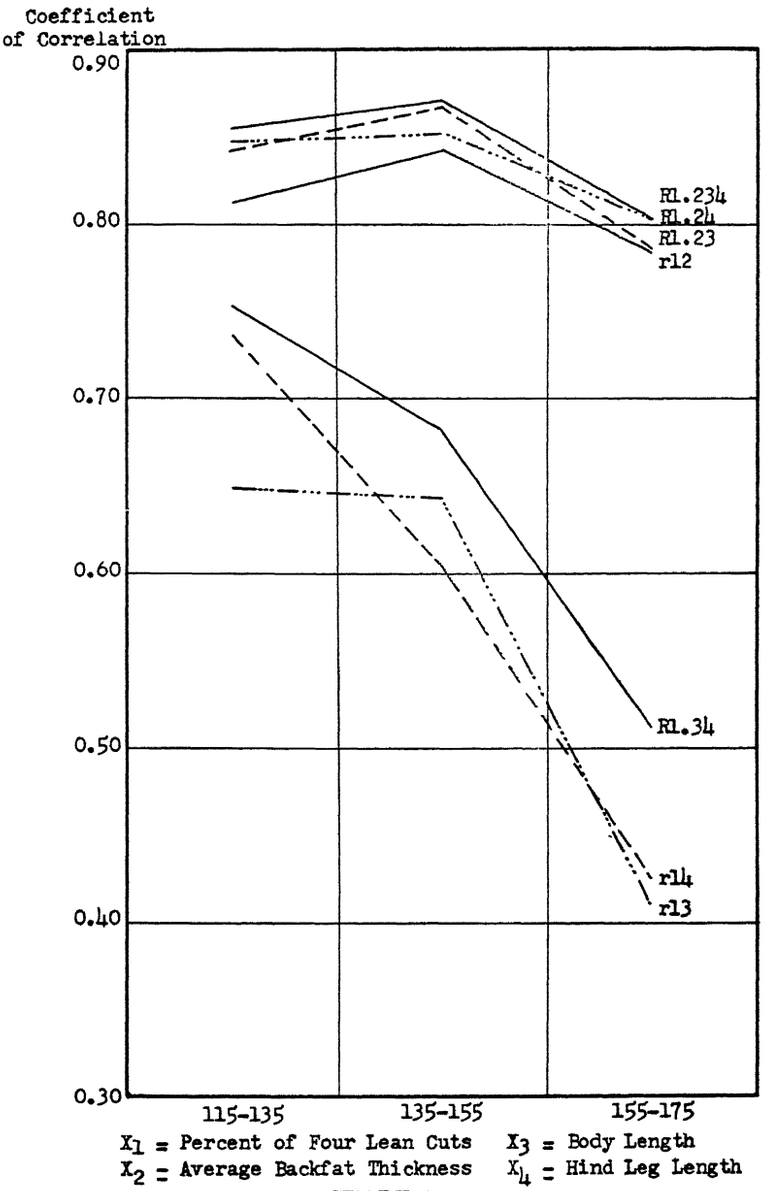


CHART 1
Comparison of the Simple and Multiple Relationships Between the Percent of Four Lean Cuts as the Dependent Variable and Various Physical Factors by Specified Weight Groups

also the lines have meaning only within the limits of the data. It appeared again that the 175-205 pound weight group was out of line with the remaining equations. This can be explained further by the fact that in the original selection of the data, there was an extremely high number of carcasses with excessive backfat thickness, and thus, logically, these carcasses were shorter in length and tended to distort the line.

One can generalize and say that with the exception of the 155-175 pound weight group, as the percentage yield of four lean cuts increases, body length increases at a decreasing rate. The regression for the 115-135 pound weight group means that for a percentage increase in the percentage yield of four lean cuts, body length increases 7.6 millimeters. The line of means indicate that as one moves from light hogs to heavy hogs, body length increases, but at a decreasing rate.

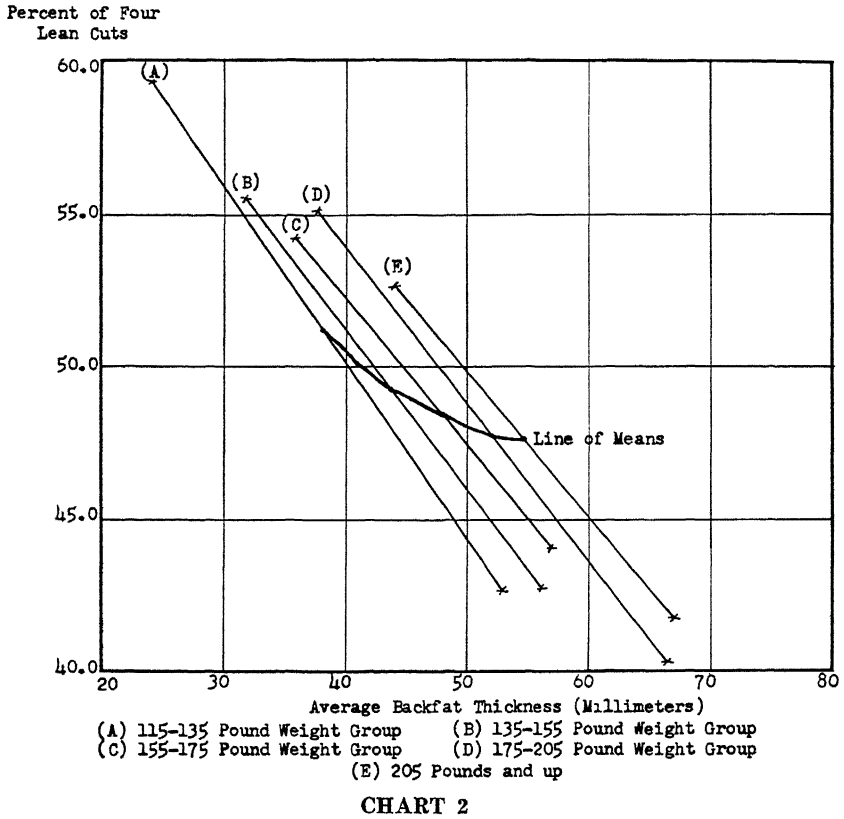
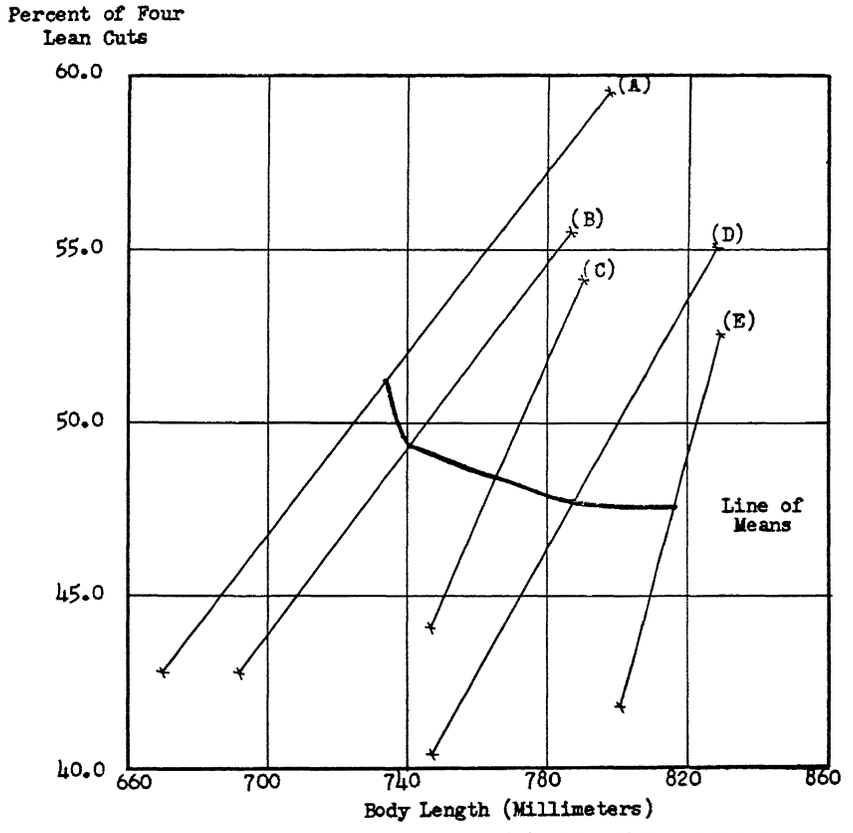


CHART 2

The Relationship Between Average Backfat Thickness and the Percent of Four Lean Cuts for Specified Weight Groups

Relationship within Selected Weight Groups

Examination of the data within selected weight groups revealed a distinct difference in the percentage yield of the four lean cuts, average backfat thickness, hind leg length, and body length. The writers arrayed each weight group into three headings: above average in percentage yield of the four lean cuts, average in percentage yield, and below average in percentage yield.



(A) 115-135 Pound Weight Group (B) 135-155 Pound Weight Group
(C) 155-175 Pound Weight Group (D) 175-205 Pound Weight Group
(E) 205 Pounds and up

CHART 3

The Relationship Between Body Length and the Percent of Four Lean Cuts for Specified Weight Groups

Chart 4 shows the regression line for the 115-135 pound weight group as a whole compared to the regression lines of the three above mentioned sub-classes with average backfat thickness and its relation to the percent of four lean cuts. This chart reveals that backfat thickness was not as important in the average percentage yielding hogs as it was in the above average and below average percentage yielding hogs. This is shown by the fact that the range for the average percentage yielding hogs amounted to only 2.8 percent in the percentage yield of the four lean cuts, associated with only a 5.8 millimeter change in average backfat thickness. The below average carcasses had a total range of 6.8 percent in the percentage yield of four lean cuts, associated with a total range in average backfat thickness of 13.1 millimeters. These results indicated that a change in backfat thickness was less significant in the average percentage yielding hogs, than in the above and below average percentage yielding hogs, but expressed as a percentage, all three groups showed practically the

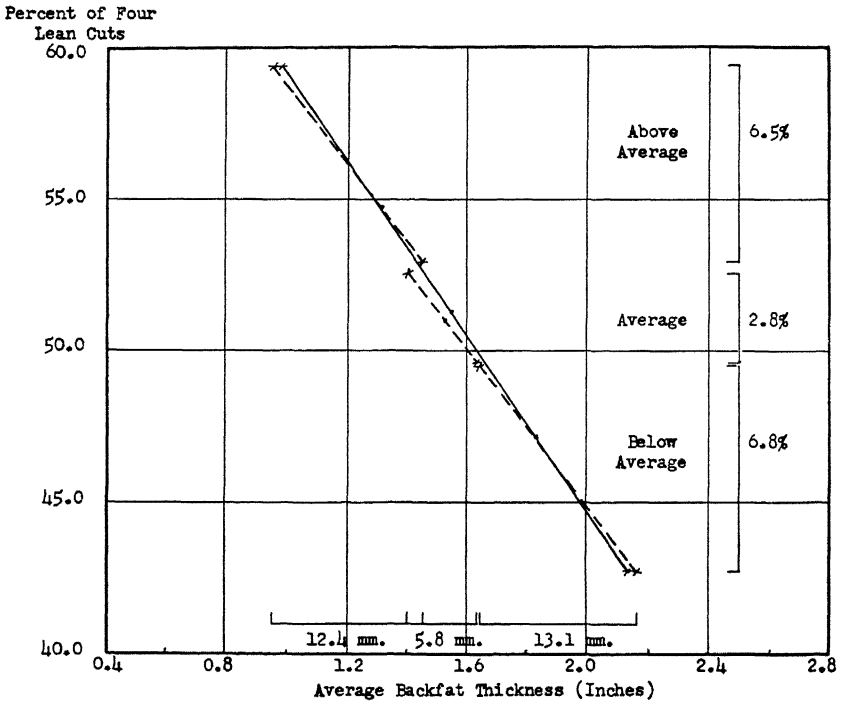


CHART 4

The Relationship of the Regression Line of the 115-135 Pound Weight Group to the Regression Lines of Three Divisions within the Weight Group Based on Above Average Yield, and Below Average Yield of the Four Lean Cuts

same relationship. In general, the individual regression lines of the sub-classes corresponded closely to the regression line of the entire weight group.

SECTION IX — DETERMINING THE SHRINKAGE OF HOG CARCASSES BY DIFFERENT WEIGHTS AND GRADES

As cooler shrinkage is an important factor in determining the final cut-out performance of hog carcasses, the Ohio Agricultural Experiment Station decided to conduct a study to determine the differences in shrinkage between hog carcasses of different weights and grades. After hog carcasses pass over the scales on the slaughtering floor, they are placed in coolers in order to chill the carcasses so that they will be firm enough to cut. The coolers help to eliminate animal heat from the carcass and aid in preservation. Cooler temperatures and the length of time in the cooler varies considerably among packing plants. Temperatures usually range from 32 to 40 degrees with an average temperature being around 34 degrees. The length of time in the cooler varies with supply and demand conditions and the amount of orders to fill on the part of the respective packers. The length of time usually ranges from 12 to 48 hours.

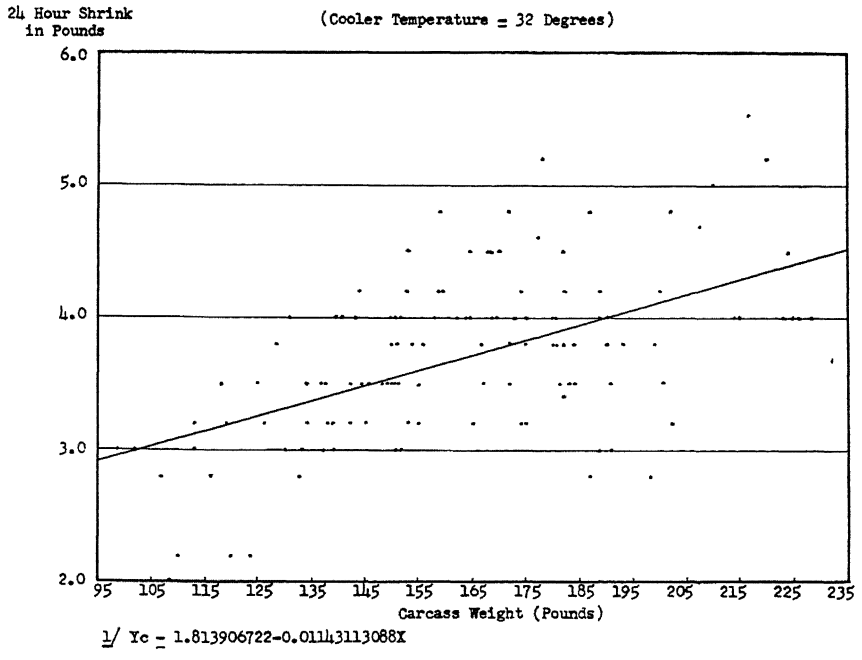


CHART 5

Shrinkage Results in Pounds of 119 Hog Carcasses[1] 24 Hours After Slaughter by Individual Carcass Weights

This leads to the question of determining the difference in shrink of hogs carcasses by weight groups. Table 16 shows the 24 hour shrink of 119 hog carcasses. Examination of this table tends toward a definite conclusion that the lighter hog carcasses shrink more per hundredweight than heavier carcasses. This means that if one is buying heavy hogs 250 pounds and up (live weight), the shrinkage will be less per hundredweight than for lighter weight hogs.

Plotting the 24 hour shrinkage of these 119 carcasses, individually, in the form of a scatter diagram as shown in Chart 5 gives a picture of how the pound shrinkage per carcass increases as one moves from light weight hogs to heavy weight hogs. Fitting a straight line equation to this data reveals that with every ten pound change in carcass weight, the shrinkage of a hog carcass increases 0.10 pound.

The results showed also that carcasses which remained in the cooler for 48 hours tended to have about one-ralf of one percent more shrink than those carcasses which remained in the cooler for only 24 hours.

Further analysis revealed that fat type carcasses tended to have less shrink than meat type carcasses. This conclusion is based on the fact that the greater amount of lean meat present in a hog carcass, the more moisture present in the tissues.

The carcass shrinkage of hogs in the cooler may not seem too important to many people at first glance. but from the packers viewpoint it is a very important factor. When one realizes that the 24 hour shrink may vary from 2.0 to 5.2 pounds for individual hog carcasses, multiplying these figures by a daily kill of 1000 hogs represents a considerable amount of weight that is lost through shrinkage. Thus, to the packers this loss due to shrinkage must be considered always as an important factor influencing the true cut-out performance of hogs.

SECTION X — DEVELOPING LIVE GRADES FROM THE EXPECTED MEASUREMENTS AND PERCENTAGE YIELDS OF HOG CARCASSES BASED ON VARIATION IN THE PERCENT OF FOUR LEAN CUTS

Having already shown that the three physical factors, average backfat thickness, hind leg length, and body length are the primary determinants of variation in the percent of four lean cuts, and ultimately, carcass value, the writers were faced with the problem of applying and testing these physical factors on a live hog basis .Up to this point, emphasis has been in selection of the factors from a carcass standpoint. Now, how can these measurements developed from the carcass be incorporated into the present system of buying and selling hogs by live weight so that this system of marketing can be improved?

Table 17 shows the physical measurements resulting from the grouping of the percent of four lean cuts into the three sub classes: above average (Grade 1), average (Grade 2), and below average

Table 16

Shrinkage Results of 119 Hog Carcasses 24 Hours after Slaughter by Weight Groups

(Cooler Temperature = 32°)

Hot Carcass Weight Group	No. Carcasses	Total Hot Carcass Weight lbs.	Total 24 Hour Cold Weight lbs.	24 Hour Shrink				
				Total lbs.	Lbs. per Carcass	Range (lbs.)	Av. Percent Per Cwt.	Range (Percent) Per Cwt.
95-105	2	200.8	195.6	5.2	2.6	2.2-3.0	2.6	2.2-3.0
105-115	5	551.0	537.8	13.2	2.6	2.0-3.2	2.4	1.9-2.8
115-125	5	596.3	582.4	13.9	2.8	2.2-3.5	2.3	1.8-3.0
125-135	9	1173.7	1143.7	30 0	3.3	2.8-4.0	2.6	2.1-3.1
135-145	13	1823.6	1777.8	45 8	3.5	3.0-4.2	2.5	2.2-2.9
145-155	18	2707.5	2642.0	65.5	3.6	3.0-4.5	2.4	2.0-2.9
155-165	11	1755.7	1711.5	44.2	4.0	3.2-4.8	2.5	2.1-2.7
165-175	14	2379.2	2323.7	55.5	4.0	3.2-4.8	2.3	1.8-2.8
175-185	16	2883.9	2822.1	61.8	3.9	3.2-5.2	2.1	1.8-2.9
185-195	10	1895.8	1858.9	36.9	3.7	2.8-4.8	1.9	1.5-2.6
195-205	6	1201.9	1179.6	22.3	3.7	2.8-4.8	1.9	1.4-2.4
205-215	2	424.0	415.0	9.0	4.5	4.0-4.5	2.1	1.9-2.4
215-225	4	882.0	864.3	17.7	4.4	4.0-5.2	2.0	1.8-2.4
225 and up	4	914.2	897.7	16 5	4.1	4.0-4.5	1.8	1 8-1 9
Total	119	19389.6	18952.1	437.5	3.7	2.0-5.2	2.3	1.4-3.1

(Grade 3). Each respective factor was arrayed and also divided into the three sub classes independent of the percentage yield of the four lean cuts. Then, based on the groupings of the percent of four lean cuts these standards were developed.

Taking the 115-135 pound weight group as an example, the carcasses above average in percent of four lean cuts (Grade 1) had backfat thickness from 1 to 1.4 inches, body length ranging from 28.0 to 34.3 inches, hind leg length ranging from 19.0 to 24.5 inches, etc. The mean of each item is the average of all the carcasses in each respective grade for each weight group. These same interpretations can apply to the other weight groups.

This is how the standards should be interpreted in terms of the live hog. Weigh the hog so as to eliminate the effect of the weight variable; estimate the backfat thickness, hind leg length, and body length; then apply the estimates to Table 17. For example, one has a hog weighing 180 pounds alive, thus, it falls into the 115-135 pound carcass weight group. One estimates the backfat thickness to be 1.6 inches, body length 27.5 inches, and hind leg length 18.5 inches. Applying these estimates to Table 17, the carcass should cut-out between 49.0 and 51.9 percent in the four lean cuts and should be classified as a Grade 2 carcass. Any variation from these measurements must be taken into account. If a live hog is estimated to have an average backfat thickness, but below average in hind leg and body length, then allowances must be made in the expected percentage yield of the four lean cuts.

The next question is whether these grades, based on the variation in the percentage yield of the four lean cuts, can be used or applied effectively in estimating the cut-out performance of the live hog rather than the carcass and can be used to live grade hogs.

SUMMARY

Since the Ohio farmer has received over 60 percent of his cash receipts from livestock sold for meat purposes from the marketing of slaughter hogs from 1947 to 1950, it is easy to see why these marketings are so vitally important to the Ohio swine producer. This was 20.8 percent of the cash receipts from all farm commodities sold in Ohio.

In the United States hogs are sold primarily on a live weight basis. In recent years research funds have been allocated towards developing an improved system of marketing hogs. The writers have been probing to see if the present system of marketing hogs can be improved, rather than change to a completely new method of buying and selling hogs.

The objectives of this study were: (1) to investigate what factors accounted for the differences in the percentage yield of the four lean cuts, between hogs of approximately the same weight and grade, and to what extent these factors can be recognized in the live hog, (2) to determine the shrinkage of hog carcasses of different weights and grades, (3) to develop standard specifications based on variation

Table 17

Tentative Expected Measurements and Percentage Yield of the Four Lean Cuts Based on Variation in the Percentage of Four Lean Cuts for Selected Weight Groups

Grade	Percentage Yield of Four Lean Cuts	Percent of Four Lean Cuts (percent)		Backfat Thickness (inches)		Hind Leg Length (inches)		Body Length (inches)	
		Aver.	Range	Aver.	Range	Aver.	Range	Aver.	Range
		170-195 Pound Live Weight or 115-135 Pound Carcass Weight							
1	Above Aver.	53.3	52.0 and up	1.40	Under 1.50	19.5	19.0 and up	28 5	28.0 and up
2	Average	50.5	49.0-51.9	1.60	1.50-1.69	18.5	18.0-18.9	27.5	27.0-27.9
3	Below Aver.	47.5	Under 49.0	1.80	1.70 and up	17.5	Under 18.0	26 5	Under 27.0
		195-220 Pound Live Weight or 135-155 Pound Carcass Weight							
1	Above Aver.	52.5	51.0 and up	1.50	Under 1.60	20.5	20.0 and up	29.5	29.0 and up
2	Average	49.5	48.0-50.9	1.70	1.60-1.79	19.5	19.0-19.9	28.5	28.0-28 9
3	Below Aver.	46.5	Under 48.0	1.90	1.80 and up	18.5	Under 19.0	27.5	Under 28.0
		220-250 Pound Live Weight or 155-175 Pound Carcass Weight							
1	Above Aver.	51.5	50.0 and up	1.70	Under 1.80	21.0	20.5 and up	30.5	30.0 and up
2	Average	48.5	47.0-49.9	1.90	1.80-1.99	20.0	19.5-20.4	29.5	29.0-29.9
3	Below Aver.	45.5	Under 47.0	2 10	2.00 and up	19.0	Under 19.5	28 5	Under 29.0

in the percent of four lean cuts that are applicable to live grades of hogs, (4) to find and point out the characteristics of a live hog which will reflect the carcass yield, and ultimately, the value of a hog carcass.

Data for 540 hog carcasses were obtained at the Columbus Packing Company (Armour and Company) plant at Columbus, Ohio. This work was started in June, 1948, and continued through June, 1949. Some portions of the analysis included 540 carcasses, while other portions dealt with varying numbers, depending upon the type of analysis.

Analysis of the data has shown a wide discrepancy by individual graders in placing a grade upon a particular carcass. Present carcass grades do not always reflect the individual grades of hams, loins, and bellies. It is suggested that present carcass grading standards be revised so that the grades for live hogs will correspond to carcass grades and then, reflect the differences in the value of carcasses produced by each individual wholesale pork cut.

Since the percentage yield of the four lean cuts comprises from 65 to almost 70 percent of the total carcass value of a hog per hundredweight, the problem, therefore, was to determine the factors in a hog carcass which caused variation in the percent of the four lean cuts. Seventeen factors, consisting of both physical measurements and percentage yields of the component parts of the carcass were correlated with the percent of the four lean cuts. Average backfat thickness was the most important single factor, followed by hind leg length and body length. These three factors together explained nearly 72 percent of the variation in the percent of the four lean cuts, assuming all other things equal. Carcass weight was a very important factor, but its influence can be appraised by taking the weight from the scales.

Temperatures in the coolers of packing plants are important in determining the final cut-out performance of hog carcasses. Analysis indicated that light hog carcasses shrink more than heavy carcasses percentagewise, and if one were buying hogs, 250 pounds and up (live weight), the shrinkage would be less per hundredweight than for light hogs. Additional results showed that by having the carcasses in the cooler 48 hours, the shrinkage increased about one-half of one percent over the 24 hour shrink.

Fat type carcasses tend to have less shrink than meat type carcasses. This is based on the generalization that the greater amount of lean meat present in a hog, the more moisture present in the tissues.

The development of a set of standards from carcass data based on variation in the percent of four lean cuts was the ultimate end of this study. It is necessary to test the applicability of these standards in the live hog in order to evaluate various possibilities of improvement in the present methods of marketing hogs. This testing was done in Part II.

Hogs Can be Graded Accurately to Reflect Value Differences

PART II

SECTION I — INTRODUCTION

With the standards developed from the basic research in Part I, the question arises as to how these standards can be used in the practical everyday marketing of live hogs. These standards are analyzed and tested in Part II.

Throughout the country several possibilities of improvement in the system of marketing hogs have been advocated by various swine and meat interests. One possibility involves a change in the present marketing system to a carcass basis of buying and selling hogs. This method is in operation at the present time in Canada and Denmark, and considerable research has been done in the United States concerning the feasibility of shifting to this method. Another possibility incorporates a method of live grading market hogs as a way of improvement.

In Part II the writers have presented these two broad approaches, along with certain modifications or combinations developed from the carcass grading or live grading methods.

Part I of this study disclosed the physical measurements of hogs associated with variation in the value of the important wholesale cuts of pork for three weight groups of hogs, ranging from 170-250 pounds (live weight). It was found that the average backfat thickness, hind leg length, and body length were the most important factors influencing the yield of the four trimmed lean cuts (hams, loins, picnics, and butts) expressed as a percentage of carcass weight, and were responsible for differences in the value of carcasses of similar weight.

With the knowledge that a change in these three physical factors was associated with a variation in the percent of four lean cuts, the writers developed tentative standards from carcass data that may be applicable to the live hog[1]. These standards were tested further in the grading of 773 hogs.

The standards subdivide the percent of four lean cuts into three classifications for each weight group of hogs: grade 1 (above average percent of four lean cuts), grade 2 (average percent of four lean cuts), and grade 3 (below average percent of four lean cuts).

The main purpose of Part II was to explore the possibilities of improving the present system of marketing hogs.

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[1]The tentative standards are given in Table 17, Part I of this bulletin.

Objectives

The objectives of Part II were designed (1) to familiarize various graders with the important physical factors affecting the percentage of four lean cuts, (2) to test the applicability of a set of standards developed from carcass data in grading live hogs, (3) to determine the accuracy of live grading hogs and the modifications of this method, (4) to determine the accuracy of carcass grading hogs by inspection and by measurement, (5) to compare the methods of live grading hogs with the carcass grading methods, (6) to further adjust and refine a set of standards that might possibly be used as a criterion for either live grading or carcass grading hogs that more nearly reflect actual carcass values.

Procedure for Factor Familiarization

The initial phase of Part II was devoted to familiarizing various graders with the selected factors. Each grader was allowed as much time as needed in examining each hog.

The hogs were sorted into three live weight groups: 170-195 pounds, 195-220 pounds, 220-250 pounds. This gave an approximate carcass equivalent range of 115 to 175 pounds, and included a major portion of the butcher hogs going to market in the eastern corn belt.

Data concerning 105 hogs were taken over a period of four weeks at the Columbus Packing House (Armour and Company) Columbus, Ohio. These hogs were subdivided into the three live weight groups on the basis of 35 hogs per weight group. This number was agreed upon as being sufficient to familiarize the graders with the important physical factors.

Each hog was examined individually and various graders estimated average backfat thickness, hind leg length, body length, and the percent of four lean cuts.

After each grader recorded his estimates of thickness, length, and percentage yield, the hogs were killed and the weight of each carcass was recorded. After a 24 hour chill, various carcass measurements were taken in the coolers and cut-out data were obtained (individual weights of the four trimmed lean cuts and the trimmed belly) on the cutting floor. The estimates of each grader were then compared with the individual carcass cut-out data.

SECTION II — FAMILIARIZING VARIOUS GRADERS WITH SELECTED FACTORS

Determining the Accuracy of Various Graders in Estimating the Selected Factors in a Live Hog

In order to determine the accuracy of the various graders in estimating the selected factors in a live hog, the factors were grouped on the basis of their respective deviations from the actual measurements, and the results are shown in Table 18.

The above table shows that the various graders were estimating average backfat thickness within plus or minus 0.2 inches of the

Table 18

Determining the Accuracy of the Various Graders in Their Estimates of the Selected Factors for Three Weight Groups of Hogs

Deviation	Percent of Hogs Within Deviation Limits			
	Graders			
	A	B	C	D
	Percent	Percent	Percent	Percent
Average Backfat Thickness				
At ± 0.2 inches	71.4	66.7	73.7	79.0
At ± 0.1 inches	36.6	51.4	46.7	52.4
Zero deviation	17.1	12.4	14.5	21.0
Hind Leg Length				
At ± 1.0 inches	71.5	76.2	80.0	49.5
At ± 0.5 inches	43.8	55.3	58.9	29.5
Zero deviation	4.8	2.9	6.7	1.0
Body Length				
At ± 1.0 inches	71.4	66.7	66.7	64.7
At ± 0.5 inches	33.3	33.3	33 3	36.2
Zero deviation	1.9	1.9	5.6	1.9
Percent of Four Lean Cuts				
At ± 3.0 percent	68.6	66.7	53.3	66.7
At ± 2.0 percent	45.7	41.9	41.1	54.3
Zero deviation	2.9	1.0	1.1	1.9

actual measurement for nearly 75.0 percent of the hogs. The estimates ranged from 66.7 to 79.0 percent at this deviation. The graders estimated approximately one-half of the hogs within plus or minus 0.1 inches of the actual measurement, ranging from 36.6 to 52.4 percent, and estimated the correct actual measurement for 12.4 to 21.0 percent of the hogs. This table indicated that the graders' estimates of the average backfat thickness between weight groups were consistent and the fluctuations small. The graders appeared to recognize differences in backfat thickness between weight groups and adjusted the standard in their own minds, accordingly.

In hind leg length, body length, and the percent of four lean cuts, a wider tolerance in the deviation was permissable, since the significant limits of these factors were much wider than the limits for average backfat thickness.

As an overall appraisal of hind leg length and body length, the graders were getting from 50 to 80 percent of the hogs within plus or minus one inch of the actual measurement, about one-third (33 percent) within plus or minus 0.5 inches, and about 5 percent with no deviation from the actual measurement. Some of the graders showed signs of inconsistency between weight groups, but Grader C remained at 80 percent for all three weight groups in estimating hind leg length.

Estimating the percent of four lean cuts was the most difficult task which faced the various graders, because this estimate depended largely on the estimate of the three physical measurements. Even so, the graders attained about 65 percent of the hogs within plus or minus 3 percent of the actual percentage yield, about 40 percent within plus or minus 2 percent, and about 25 percent within plus or minus 1 percent. The results showed also that the graders were fairly consistent in their estimates between weight groups.

Closer examination of some of the cases where all the graders missed estimating the actual percent of the four lean cuts by a large amount (5 to 7 percent), showed that the graders missed their estimates of average backfat thickness by a large amount (0.4 to 0.6 inches) also, and that their estimates of hind leg length and body length were from 0.3 to 1 inch short or long.

With a typical or average hog in each of the subclasses of the percent of four lean cuts, above average, average, and below average, the length measurements have only a minimum effect upon the percent of four lean cuts, and average backfat thickness is the prime determinant of yield. But, in every case, a hog that is longer or shorter in length than the typical or average hog in each subclass, average backfat thickness plus the combination of the length factors are the primary determinants of the percentage yield of the four lean cuts. Thus, any time there is a hog that departs from the average, the combined effect of all the selected factors is the best indicator of the percent of the four lean cuts.

Here is an illustration of how this works:

	Hog A	Hog B
Carcass Weight	145.0 pounds	145.0 pounds
Average Backfat	1.5 inches	1.7 inches
Hind Leg Length	20.0 inches	20.0 inches
Body Length	29.5 inches	29.5 inches
Percent of 4 Lean Cuts	52.0 percent	52.0 percent

Hog A represents a grade 1 hog, above average in yield of the four lean cuts in the 115 to 135 pound weight group. The measurement of average backfat thickness alone, definitely places it as a grade 1 hog. In this case the length measurements verify also this hog as grade 1, but these measurements have only a minimum effect upon the percent of four lean cuts, and average backfat thickness is the prime determinant of yield.[1]

Hog B is an example of the departure from a typical or average hog. The average backfat measurement alone would place this hog in the No. 2 grade, but its yield in the percent of four lean cuts places it in the No. 1 grade. Examination of the length measurements reveals a longer body and hind leg length than expected for a hog with 1.7 inches of backfat. Thus, in this example backfat thickness plus the combination of the length factors are the primary determinants of the percentage yield of the four lean cuts.

[1]It's always well in comparing actual hog carcasses to keep in mind any differences that might be due to measuring and cutting errors.

It was satisfying in this phase to see the favorable results which were shown by some of the various graders in their ability to estimate the measurements and percentage yield of these hogs. It was noticeable particularly that when one grader missed an estimate by a large amount, most of the other graders were consistent and did likewise in most cases. This indicated that the graders were seeing the same factor in the hogs and were conscious of a common standard.

As this phase of the study was designed to acquaint and familiarize the graders with the important factors which explained the greatest amount of variation in the percent of the four lean cuts, the writers felt that making the graders "factors conscious" was a step toward reorienting their thinking toward a common standard. The next logical step was to determine whether the entire process could be speeded up and integrated into the present system of marketing hogs by live weight on a more practical basis.

SECTION III — LIVE AND CARCASS GRADING HOGS

Procedure

The second phase of Part II was designed to simplify the procedure and expedite the process of grading hogs. Rather than estimate the selected factors, each grader, keeping these factors in mind, graded the hog as No. 1, No. 2, or No. 3 after the hogs were sorted by live weight groups.

The hogs were selected as they were delivered by the producers to the yards of the Columbus Packing Company (Armour and Company) Columbus, Ohio. Seven hundred seventy-three hogs, divided into 16 different lots were selected over a period of four months. The hogs were separated into three live weight groups or their approximate carcass equivalent weight groups as follows: 170-195 pound live weight group (115-135 pound carcasses) 263 hogs, 195-220 pound live weight group (135-155 pound carcasses) 252 hogs, and the 220-250 pound live weight group (155-175 pound carcasses) 258 hogs. The same measuring, cutting and weighing procedures as used in Part I of the study were followed to obtain the percent of the four lean cuts.[1]

[1]Trimming standards are given in the Appendix.

All graders participated in the grading of the first five test lots, and placed an individual grade on each hog. The next five lots were assigned to a particular grader who was responsible for live grading these particular test lots. The other graders observed this procedure, and recorded any disagreement.

The last six tests lots were sorted first by live weight groups, and resorted by live grades. This entire process for the hogs in a test lot was done in a very short time with each grader recording a grade of No. 1, No. 2 and No. 3 as the hogs passed through the sorting gate. There was a great deal of emphasis upon speed in order to determine the accuracy of the graders under normal buying conditions.

The Accuracy of Live Grading Hogs

One of the principal objectives of Part II was to determine the accuracy of live grading hogs.

Results revealed that grader A was the most accurate and consistent in live grading all of the lots of hogs. In all lots his lowest percentage of the number correct was 40.5 percent and his highest percentage was 64.4 percent. In eight out of the 16 lots, grader A's percentage was over 57 percent correct. Grader B's score was wider in range and his results varied from 30.8 to 69.8 percent correct. Grader C showed a spread of 41 to 61 percent correct.

The summation of all lots by weight groups is shown in Table 19. The overall results revealed that all graders seemed to have the most difficulty with the light weight carcass group, 115 to 135 pounds. Grader A correctly estimated approximately 60 percent of the hogs in the 135-175 pound carcass group in the correct grade, while grader B estimated about 55 percent correct for the same weight groups.

These grading results indicate that the live grading of hogs can be accomplished, and that the accuracy of the graders should improve with additional grading experience.

Comparison ot Carcass Grading and Live Grading Hogs

Considerable work has been done the past few years concerning the practicability of incorporating the Canadian system of marketing hogs by the carcass method of grading into the United States.

In order to compare the carcass method of marketing hogs with the live grading of hogs as done in this study, 432 hogs were given a carcass grade by the participating graders. The graders did not take any measurements, but graded each carcass by inspection. independent of each other, as it hung on the rail in the cooler. The results of these carcass grades are shown in Table 20.

The comparison of the accuracy of the carcass grades with the live grades (Table 19) for the same hogs by the same graders revealed that grader A obtained 55.9 percent accuracy in live grading, and 55.8 percent accuracy in carcass grading. Grader B was getting 9.0 percent more hogs in the right grade by carcass grading than he did by live grading, and grader C 10.6 percent.

On a test lot basis the results from carcass grading and live grading revealed about the same percentage of accuracy. Carrying this conclusion further, this means that if live grading can be incorporated into the present system of marketing hogs with little change in the present technique, it might improve the markeing system. Although carcass grading involves a change in the manner of marketing hogs, a modification of this method might prove also to be more satisfactory than live grading.

Measurement Grading of Hog Carcasses

In addition to the carcass grading of hogs by inspection, is it possible for the measurement of average backfat thickness to determine the grade of the carcass? Using the standards for average backfat thickness as established in Table 25, the following results were obtained:

Table 19

The Accuracy of Live Grading Hogs by Various Graders for All Lots of Hogs in Three Weight Groups

Carcass Weight Group	Total Number	Graders								
		A			B			C		
		No. Graded	No. Right	Percent Right	No. Graded	No. Right	Percent Right	No. Graded	No. Right	Percent Right
115-135	210	181	85	47.0	168	78	46.4	140	64	45.7
135-155	226	195	113	57.9	181	96	53.0	150	80	53.3
155-175	228	198	123	62.1	185	104	56.2	155	80	51.6
Total	664	574	321	55.9	534	278	52.1	445	224	50.3

Table 20

The Accuracy of Carcass Grading Hogs by Inspection by Various Graders for All Lots of Hogs in Three Weight Groups

Carcass Weight Groups	Number Graded	Graders					
		A		B		C	
		No. Right	Percent Right	No. Right	Percent Right	No. Right	Percent Right
115-135	135	72	53.3	84	62.2	83	61.5
135-155	153	87	56.9	87	56.9	99	64.7
155-175	144	82	56.9	93	64.6	81	56.2
Total	432	241	55.8	264	61.1	263	60.9

Table 21

The Percentage of Accuracy of Average Backfat Thickness Determining the Grade of Hog Carcasses

Grade	115 to 135 lbs.		135 to 155 lbs.		155 to 175 lbs.	
	Total No.	Percent Right	Total No.	Percent Right	Total No.	Percent Right
Grade 1	55	63.6	39	74.4	39	69.2
Grade 2	125	76.8	149	64.4	146	61.6
Grade 3	30	80.0	38	52.6	43	76.7

For all grades and weight groups, the percentage of accuracy with average backfat thickness as the basis of the grade, ranged from 52.6 to 80 percent correct. The accuracy as indicated by this method of grading revealed fairly consistent results, and further verifies the grade standard established. The possibilities of using average backfat thickness as the sole determinant of grade, works well with a typical or average hog in each grade, but when one departs from this typical or average hog, the influence of the length factors must be taken into consideration in determining the final grade.

SECTION IV — THE RELATIONSHIP OF THE ACTUAL GRADE AND THE VALUE OF THE FOUR LEAN CUTS PER HUNDREDWEIGHT

If standards developed from carcass data and based on differences in the percentage yield of the four lean cuts are to be used as a measuring stick for determining the actual grade of the live hog, then the value per hundredweight of the four lean cuts should verify also the actual cut-out grade of the hog.

Table 22 shows the average value and the range in value of the four lean cuts per hundredweight by grades for the three carcass weight groups.

Examination of the average values per hundredweight of the four lean cuts for the 115-135 pound carcass weight group revealed that on the average, grade 1 hogs were worth $1.19 more than grade 2 hogs, and grade 2 hogs were worth $1.14 more than grade 3 hogs. In both, the 135-155 and 155-175 pound carcass weight groups, grade 1 hogs on the average were worth .95 cents and $1.04 respectively more than the grade 2 hogs. The grade 2 hogs of the middle weight group were worth $1.03 more than the grade 3 hogs of the same weight group, while in the 155 to 175 pound weight group there was a .99 cent spread between the grade 2 and 3 hogs.

Further results indicated that the average differential of the per hundredweight value of the four lean cuts between weight groups for grade 1 hogs amounted to .79 cents between the light and medium weight groups, and .36 cents between the medium and heavy weight groups. For grade 2 hogs the differential was .55 cents between the light and medium weight groups, and .45 cents between the medium

and heavy weight groups. The differential of grade 3 hogs amounted to .44 cents between the light and medium weight groups, and .41 cents between the medium and heavy weight groups.

These figures indicate a greater difference between the average values of the four lean cuts per hundredweigth by grades in the 115-135 pound carcass weight group than in the medium or heavy weight groups. This differential ranged from 15 to 24 cents.

This analysis shows that the developed standards represent an adequate measuring stick for determining values in grading hogs.

Does the Live Price Currently Paid for Hogs Accurately Reflect the Value of the Four Lean Cuts and the Actual Grade of Hog Carcasses?

The hogs in the second phase of this study were bought on a live weight basis by the packing plant at the regular quoted prices of that particular day in which a test lot was being conducted.

In order to compare the prices paid for these live hogs with the actual value per hundredweight of the hogs on the basis of their cut-out performance of the percent of four lean cuts, the writers attempted to determine the number of hogs that were overpaid for and underpaid for on the basis of their cut-out performance.

Analysis in Part I has indicated that the value of the four lean cuts comprised from 65 to 70 percent of the total carcass value per hundredweight, and was responsible for the differences in total carcass value. For carcasses weighing 115-135 pounds the figure amounted to 69 percent, for carcasses weighing 135-155 pounds, 68 percent, and for carcasses weighing 155-175 pounds, 67 percent. In other words, as carcass weight increased the per hundredweight value of the four lean cuts comprised a smaller proportion of the total carcass value per hundredweight.

An illustration will reveal the procedure involved in this process. In the 155-175 pound carcass weight group, two hogs were actually purchased alive at the quoted price for that particular day of $22.75 per hundredweight.

The question asked was whether or not this price of $22.75 accurately reflected the value of the four lean cuts in the actual grade in which these hogs cut-out. The results are shown in Table 23.

Table 23

Comparison of the Live Price of Hogs and the Value of the Four Lean Cuts Per Hundredweight Based on the Actual Grade of the Hog Carcass

Hog No.	Carcass Weight	Live Price (A)	67 Percent of the Live Price (B)	Per Hundred-weight Value Of the Four Lean Cuts (C)	Difference Between (B) and (C)	Actual Carcass Grade	Possible Live Price (C/67x100)
1	156.8	$22.75	$15.24	$16.63	$+1.39	1	$24.82
2	159.7	22.75	15.24	15.11	-0.13	3	22.55

Based on the actual grade of each carcass and the value of the four lean cuts, hog No. 1 could have been purchased alive for $2.07 more than the $22.75 actually paid, and hog No. 2 could have been purchased alive for 0.20 cents less. This indicates that if these two hogs had been purchased on the basis of their actual cut-out performance according to live grade, hog No. 1 could have brought $24.82 and hog No. 2, $22.55 on a live weight and grade basis.

This same procedure as shown above was worked out for 425 hogs in their respective weight groups. The distribution of hogs grouped by the differential between a stated percent of the live price and the per hundredweight value of the four lean cuts is shown in the following table.

Table 24

The Distribution of the Number of Hogs Grouped by the Differential Between a Stated Percent of the Live Price and the Per Hundredweight Value of the Four Lean Cuts

Differential in Value	Carcass Weight Group			Total No. of Hogs	Percent
	115-135	135-155	155-175		
+$5.01 and up	2	0	0	2	0.5
+$4.51 to 5.00	3	0	0	3	0.7
+$4.01 to 4.50	5	0	1	6	1.4
+$3.51 to 4.00	7	1	2	10	2.4
+$3.01 to 3.50	18	12	5	35	8.2
+$2.51 to 3.00	19	15	16	50	11.8
+$2.01 to 2.50	18	26	21	65	15.3
+$1.51 to 2.00	19	25	34	78	18.4
+$1.01 to 1.50	20	26	25	71	16.7
+$ .51 to 1.00	6	22	21	49	11.5
+$ .01 to .50	9	16	10	35	8.2
-$ .01 to .50	5	2	6	13	3.1
-$ .51 to 1.00	1	3	0	4	0.9
-$1.01 to 1.50	0	3	1	4	0.9
Total plus Deviations	126	143	135	404	95.1
Total minus deviations	6	8	7	21	4.9
Total Number	132	151	142	425	100.0

This table indicated that 95.0 percent of the 425 hogs were worth more than the actual live price quoted for these hogs on their particular day of purchase, based on the percentage yield and value of the four lean cuts. It would seem logical that the hogs which were graded as No. 1's might be worth more on the basis of their grade, but in each of these weight groups the grade 1 hogs comprised only about 26.0 percent of the total number involved.

This in no way implies that packers bought these hogs at bargain prices, but it does mean that the current method of live pricing (the present system) does not reflect differences in the cut-out performance of hogs.

SECTION V — ADJUSTED STANDARDS FOR GRADING HOGS

After testing the tentative standards developed in Part I on more than 773 hogs, the writers have concluded that the tentative standards should be revised slightly as presented in Table 25.

This table of expected measurements, based on differences in the percentage yield of the four lean cuts, was developed from carcass data. These measurements for gardes 1, 2, and 3 by weight groups have been tested on 773 hogs, and the results of grading by these standards has indicated to the writers that it may be used as a measuring stick in grading. It is to be used as a guide by the hog buyer and hog salesman to indicate the range of the physical measurements and the percent of four lean cuts that a particular grade of hog should attain. For example, a hog graded as No. 1 in the 170-195 pound live weight group should result in 52.5 percent or more percentage yield of the four lean cuts, should have a backfat thickness of 1.4 inches and under, hind leg length of 18.7 inches and up, and body length 28.0 inches and up. Similar procedure is followed for a hog graded as No. 2 or No. 3.

To give the hog buyer and the hog salesman a more complete guide for buying and selling operations, Table 26 is presented. This table shows the average percent and the range in percent of the five primal cuts of a hog by weight groups and by grades. It must be kept in mind that the standards for wholesale cuts are based largely on the practice for trimming followed by Armour & Company. Other slaughterers in the Eastern belt follow similar cutting practices, but they may vary for other sections of the country.

Hogs Included in the Overlap of Grades

The standards as developed in Table 25 reveal an overlap in the percent of four lean cuts of grades 1 and 2, and grades 2 and 3. This overlap amounts to 1.0 percent in the 115 to 135 pound weight group, and 0.5 percent for the medium and heavy weight groups.

The following hogs illustrate actual examples in the 115 to 135 pound weight group:

	Hog A Low 1 Grade	Hog B High 2 Grade	Hog C Low 2 Grade	Hog D High 3 Grade
Average Backfat	1.5 in.	1.6 in.	1.7 in.	1.8 in.
Hind Leg Length	18.9 in.	18.9 in.	18.5 in.	17.2 in.
Body Length	27.6 in.	25.7 in.	26.8 in.	29.8 in.
Percent of Four Lean Cuts	52.3 %	51.8 %	48.3 %	47.8 %

If a grade was placed individually on each measurement, hog A would grade 2 in backfat thickness, grade 1 in hind leg length, and grade 2 in body length. Yet this hog yielded 52.3 percent in the four lean cuts, and is included as an overlap, low 1 grade hog. Similar statements can be made concerning hogs B, C, and D, each representing an overlap grade.

Table 25

Adjusted Standards for Grading Hogs
for Three Weight Groups

Weights and Grades		Percent of Four Lean Cuts Percent	Backfat Inches	Body Length Inches	Hind Leg Inches
Carcass Wt. 115-135 lbs. Equivalent Live Wt. 170-195 lbs.		Range	Range	Range	Range
	Grade 1	52.5 and up *	1.4 and under	28.0 and up	18.7 and up
	2	48.5 - 51.4 **	1.5 - 1.7	27.5 - 27.9	18.4 - 18.6
	3	Under 47.5	1.8 and up	Under 27.5	Under 18.4
Carcass Wt. 135-155 lbs. Equivalent Live Wt. 195-220 lbs.					
	Grade 1	51.5 and up *	1.6 and under	29.0 and up	19.6 and up
	2	47.5 - 50.9 **	1.7 - 1.9	28.5 - 28.9	19.1 - 19.5
	3	Under 47.0	2.0 and up	Under 28.5	Under 19.1
Carcass Wt. 155-175 lbs. Equivalent Live Wt 220-250 lbs.					
	Grade 1	51.0 and up *	1.7 and under	30.0 and up	20.1 and up
	2	47.0 - 50.4 **	1.8 - 2.0	29.2 - 29.9	19.4 - 20.0
	3	Under 46.5	2.1 and up	Under 29.2	Under 19.4

* Includes the overlap of grades 1 and 2
** Includes the overlap of grades 2 and 3

Table 26

Hams, Loins, Picnics, Butts, and Bellies Expressed as a Percentage of Carcass Weight by Grades

Carcass Weights and Grades	Hams		Loins		Picnics		Butts		Bellies	
	Average	Range	Average	Range	Average	Range	Average	Range	Average	Range
115-135										
Grade 1	20.0%	18.4-22.6%	16.0%	14.7-18.8%	10.0%	8.5-11.3%	7.8%	6.9-9.5%	15.0%	12.6-17.4%
Grade 2	18.6	16.9-20.2	14.7	11.6-16.8	9 3	7.9-10.7	7.2	5.9-8.9	16.3	13.3-18.5
Grade 3	17.5	16.0-18.6	13.5	11.7-14.8	8.9	8.1- 9.6	6.6	5.9-7.7	17.3	15.3-19.8
135-155										
Grade 1	19.5	18.0-21.0	15.7	13.8-17.3	9.6	8.2-11.1	7.6	6.4-8.3	15.8	12.9-18.2
Grade 2	18.5	16.7-20.6	14.6	12.4-16.3	9.1	7.6-10.3	7.1	5.7-8.3	16.3	13.6-20.0
Grade 3	17.2	15.5-20.4	13.4	11.3-14.7	8.8	8.1- 9.6	6.7	5.4-7.6	17.8	14.5-20.5
155-175										
Grade 1	19.6	18.4-20.9	15.6	14.4-18.4	9.5	8.4-10.7	7.4	6.3-8.0	15.6	12.6-17.3
Grade 2	18.3	16.4-20.2	14.4	12.5-16.3	9.0	7.9-10.4	7.0	5.9-8.2	16.8	13.7-19.8
Grade 3	16.9	15.2-17.8	13.4	11.8-14.8	8.4	7.7- 9.2	6.6	5.6-7.3	17.7	15.7-21.3

Dressing Percentage by Grades of Hogs

Table 27 shows the average and the range in dressing percentage by grades for three weight groups of hogs. In the 115 to 135 pound weight group, the average dressing percentage for grade 1 hogs was 68.3 percent with a range of 61.7 to 73.3 percent. This range of 11.6 percent was typical of the wide ranges in all grades in the 115 to 135 pound weight group.

For all carcass weight groups, the lowest average dressing percentage occurred in grade 1 hogs, and the highest dressing percentage in grade 3 hogs. If the grade standards are reasonably accurate, this situation is expected because the grade 3 hogs have a higher proportion of fat cuts in relation to lean cuts, than do hogs graded as 1 or 2.

This dressing percentage factor must be considered in buying hogs on a live grade basis. If hogs were bought on a carcass basis, this factor could be disregarded.

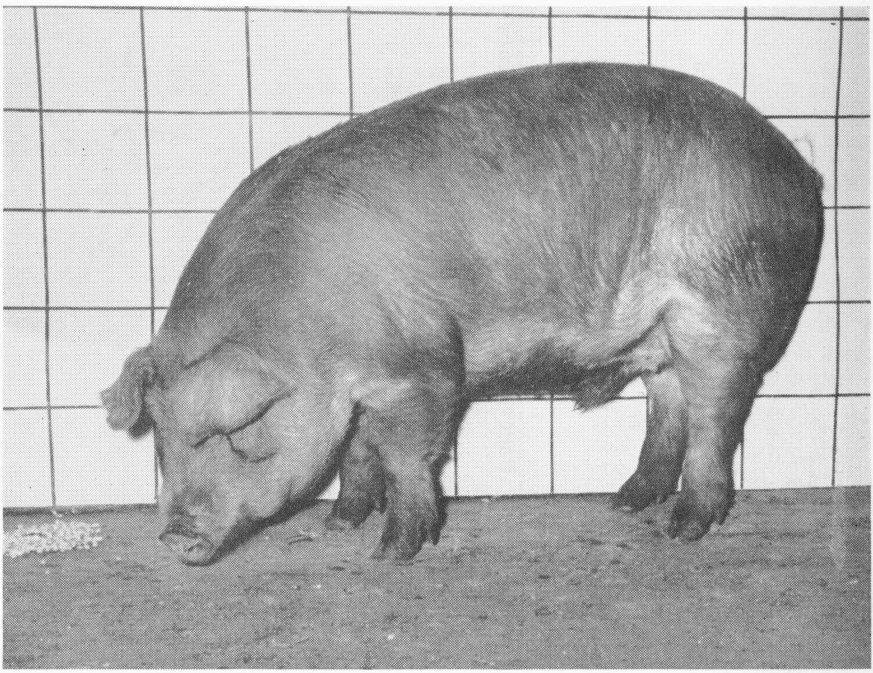

Figure 1. This was termed a grade 1 hog and had an average dressing percentage of 68.3 for the 115 to 135 pound grade. Too, it was highest in the percentage of lean cuts.

Summary

Various possibilities of improvement in the present method of marketing hogs in the United States have been mentioned by various livestock and meat interests. One possibility involves a change in the present marketing system to a carcass basis of buying and selling hogs. Another possibility suggests incorporating the live grading of hogs into the present marketing system, based on the standards previously discussed, in order to improve the marketing system and still maintain the present techniques.

The writers have presented these two broad approaches along with certain modifications or combinations developed from carcass grading or live grading.

The objectives were: (1) to familiarize various graders with the important factors affecting the percent of four lean cuts, 2) to test the applicability of a set of standards developed from carcass data in grading live hogs, (3) to determine the accuracy of live grading hogs and the modification of this method, (4) to determine the accuracy of carcass grading hogs, by inspection and by measurement,

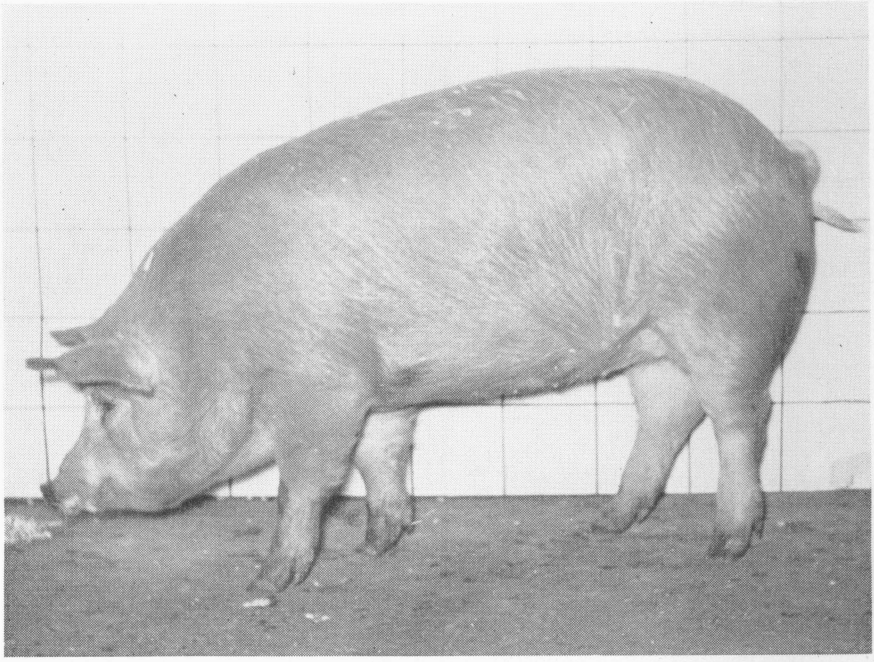

Figure 2. A hog of this type received a grade 2 rating. It was slightly over the grade 1 hog in backfat thickness and had a lower percentage of the four lean cuts.

(5) to compare the methods of live grading hogs with the carcass grading methods, (6) to further adjust and refine a set of standards that might possibly be used as a criterion for either live grading or carcass grading hogs that more nearly reflect actual carcass values.

The initial phase of Part II was designed to acquaint and familiarize various graders with the important factors (average backfat thickness, hind leg length and body length) which explained the greatest amount of variation in the percent of four lean cuts. Four graders estimated these selected factors for 105 live hogs over a period of four weeks at the Columbus Packing Company (Armour and Company). Individual weights of the hams, loins, picnics, butts, and bellies were recorded after the hogs were slaughtered.

The graders' estimates of average backfat thickness showed that some had a tendency to overestimate, while others tended to underestimate the factors. The graders recognized differences in average backfat thickness between weight groups, and adjusted the standard in their own minds, accordingly.

The estimates of hind leg length, body length, and percent of four lean cuts were fairly consistent, but some graders tended to do better on certain weight groups than others. Even so, the graders

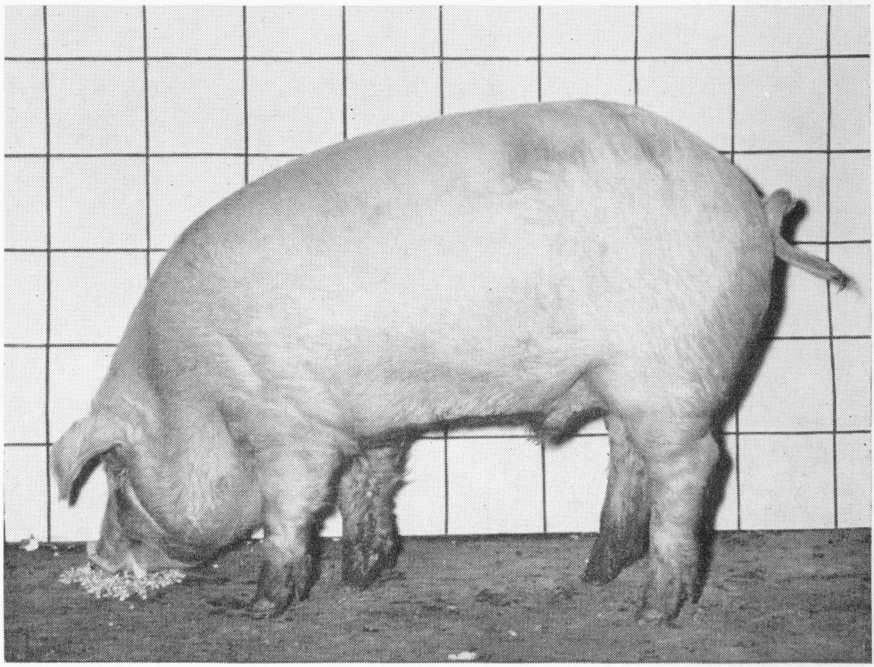

Figure 3. This grade 3 hog dropped about 5 percent in the four lean cuts and had about 0.3 inches more backfat than did a grade 1 hog.

placed from 50.0 to 80.0 percent of the hogs within plus or minus one inch of the actual measurement for body length and hind leg length. Since the estimate of the percent of four lean cuts depended largely on the estimate of the three physical factors, some graders excessively high or low in their estimation of a physical factor, were also high or low in their estimate of the percent of four lean cuts.

The second phase of Part II was designed to simplify the procedure and integrate this grading process into the present system of marketing hogs. Rather than estimating the selected factors, the graders graded each hog as No. 1, 2, or 3 after the hogs were sorted by live weight groups. Seven hundred seventy-three hogs were live graded over a period of four months. Cut-out data on the important individual cuts were obtained from the cutting floor.

All graders placed an individual grade on the first five lots, while the second five lots were assigned to a certain grader, who was responsible for live grading these particular test lots. In this latter phase, emphasis was upon speed to determine the accuracy of the graders under normal buying conditions.

Grader A did the best job of grading, and was the most consistent grader for all of the lots of hogs. The number of hogs in the correct

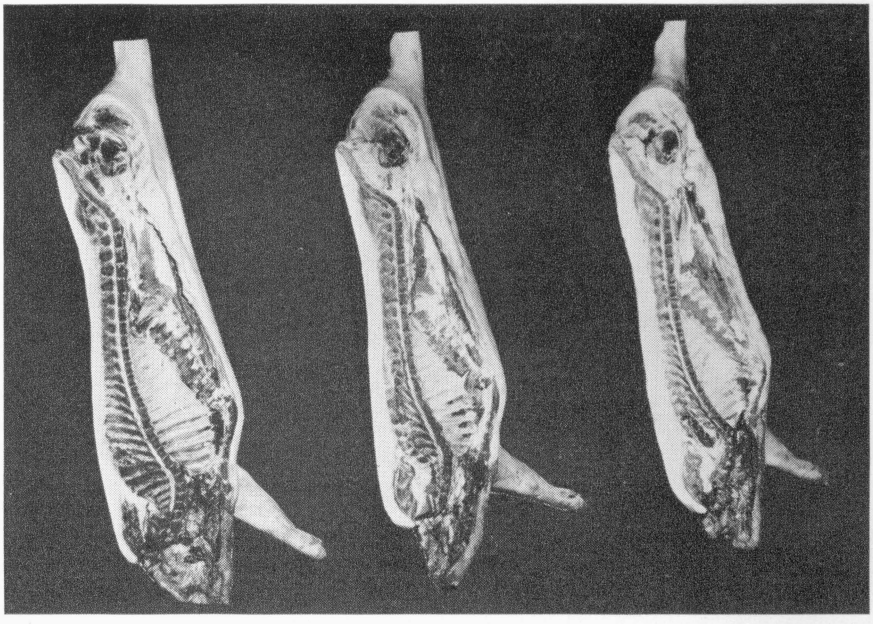

Figure 4. Best carcass is that on the left with a thinner layer of backfat and of course more lean meat throughout the carcass. The other two were graded lower and the cross section view shows that the backfat is thicker on both.

Table 22

The Average Value and the Range in Value Per Hundredweight of the Four Lean Cuts of Hogs by Actual Cut-out Grade for Weight Groups

Carcass Weight Group	Grade 1			Grade 2			Grade 3		
	No. Hogs	Average Value	Range in Value	No. Hogs	Average Value	Range in Value	No. Hogs	Average Value	Range in Value
115-135	55	$18.32	$17.66-20.66	125	$17.13	$16.25-17.84	30	$15.99	$15.21-16.51
135-155	39	17.53	17.11-18.14	149	16.58	15.67-17.64	38	15.55	14.87-16.15
155-175	39	17.17	16.61-18.38	146	16.13	15.48-16.73	43	15.14	14.51-15.45

Table 27

Dressing Percentage by Grades of Hogs

Carcass Weight Group	Grade 1			Grade 2			Grade 3		
	No. Hogs	Average	Range	No. Hogs	Average	Range	No. Hogs	Average	Range
115-135	55	68.3%	61.7-73.3%	125	69.7%	63.0-75.7%	30	71.4%	66.2-79.0%
135-155	39	70.3	64.5-74.6	149	70.6	66.1-76.0	38	71.5	68.8-75.1
155-175	39	70.4	66.3-74.8	146	71.9	65.5-76.0	43	72.4	68.4-75.8

grade ranged from 40.5 to 64.4 percent by lots. Other graders showed wide variation in the percentage correct.

Comparison of live grading with carcass grading for 432 hogs revealed about the same percentage of accuracy, with a slightly better accuracy for carcass grading.

Analysis showed also that the live price currently paid for hogs does not reflect the actual value of the four lean cuts based on cut-out performance in the proper live grade. The live price for some hogs is too high, while others it is too low, with little consideration given to cut-out performance.

The writers have developed standards that may be used as a guide by the hog buyers and hog salesmen, to indicate the range of physical measurements, based on variation in the percent of four lean cuts, that a particular hog should attain.

It must be concluded that both the live grading methods and the carcass grading methods are worthy of consideration in improving the system of marketing hogs.

APPENDIX

HOG CARCASS MEASUREMENTS

Standard measuring procedures were prepared by the regional committee to be used by all participating states. All measurements were taken in millimeters to facilitate calculation.

Length

Measured from the junction of the last cervical and first thoracic vertebrae to the lowest point (as the carcass hangs) of the aitchbone.

Thickness of Backfat — (All backfat measurements to include skin).

Over First Rib — At the junction of the last cervical and first thoracic vertebrae.

Over Last Rib — At the junction of the seventh and eighth vertebrae.

Over Last Lumbar — At the junction of the last thoracic vertebrae and the sacrum.

Thickness of Belly Pocket

The thinnest portion of the belly opposite the junction of the second and third vertebrae counting down from the pelvic arch. To be measured with a skewer.

Length of Ham

Measured from lowest point of aitchbone to inside of hock joint on the center of the bony projection which may be felt beneath the skin just above (as the carcass hangs) the center of the hock joint itself.

Width Through Ham

Width from top point of aitchbone to the outside of ham on a line parallel to the floor. This measurement is the length of a line perpendicular to the sagittal plane bisecting the carcass. To be measured from the rear of the carcass with calipers. Sum of both measurements is recorded.

Width Through Shoulders

Width from center of first thoracic vertebrae to outside of shoulder on a line parellel to the floor. This measurement is the length of a line perpendicular to the sagittal plane bisecting the carcass, to be measured from the rear of the carcass with calipers. Sum of both measurements is recorded.

Length of Hind Leg

Measured from the edge of the dew claw to the lowest point of the aitchbone.

PROCEDURE FOR CUTTING PORK CARCASSES AND TRIMMING CUTS

Upon conferring with Armour and Company officials, it was decided that the Armour standard cutting procedures would be used, rather than the regional specification. The following cutting pro-

cedure prepared by Armour and Company officials was followed in the Ohio study.

Hams: Hams are to be sawed and cut from the side not less than 2½ inches nor more than 2¾ inches from the exposed end of the aitchbone.

All hams 10 pounds and over are to be made into skinned hams. The foot is to be removed at the closed joint of the hock. Hams are to be skinned on an angle 15 to 18 degrees, starting at a point on the cushion side three inches from the wrinkle at the base of the hock on hams under 18 pounds, and three and one-half inches from the wrinkle at the base of the hock on hams over 18 pounds. Hams are to be fatted to carry not over three-fourths inches of fat over the back, bevel the fat down at the butt to meet the lean at the butt of the ham.

Hams are to be graded as: Star, Melrose, Banquet or Colonial according to quality.

Splitting Sides: The backbone is split so as to make two similar halves of carcasses.

Bellies: Full brisket to be left on the belly but trim enough to remove shoulder muscle. Remove heavy gristle bone. Bellies to be square cut, except that the flank is to be cut on a bias of ¾ inch to one inch. All bellies to be seedless. Bellies may carry ¾ inch of fat back if the scribe mark is not too prominent, and if the fat back portion is covered with lean.

Grade bellies as: Star, Melrose, Banquet, Colonial or End Squared and Dry Salt, according to quality, dimension and weight.

Fat Backs: Grade and save all suitable for cure. Those too thin for cure should be shown as rejects. Those saved are to be of reasonably uniform thickness.

Remove all lean and seam meat. The bias at the ham end is to be completely removed to square the end. Also the shoulder end is to be trimmed square if the back has been damaged in the shoulder chopping operation. All backs are to be trimmed not to vary over one and one-half inch in width from one end to the other and all ragged or semi-loose pieces are to be removed.

Picnics: To be produced from rough shoulders cut from the side at least one and one-half ribs wide, or in such a manner so as not to expose the ridge bone of the blade or leave any shoulder muscle on the belly. The shank is to be removed at the closed joint (upper knee joint towards the body of the hog).

The breast flap is to be removed — entire lip removed. All blood clots should be removed from the face of the picnic. Picnic is to be undermined or backstrapped one to one and one-half inches from the edge of lean at the butt of the picnic. The fat is to be beveled evenly and the edges of the butt rounded to give a neat appearance.

Boston Butts: Boston butt is to be sawed from the shoulder in the regular manner making the cut at the butt parallel to the breast

flap, leaving approximately one and one-half to two inches of the bladebone in the picnic. To be closely trimmed and properly faced, with the rib, lip and breast flap and jowl butt removed. Well rounded with the fat properly beveled on the butt end.

Pull butts from the plate with a thin uniform covering of fat not exceeding one-half inch in thickness, the lean seam of which is well exposed. In the event the butt pullers fail to expose the lean seam meat on the back of the butt, it will be necessary that the operators retrimming butts expose the lean seam meat. The trimmers also must remove any fat in excess of one-half inch and bevel the edges neatly down to the lean.

Pork Loins: The fat covering over the back should not exceed one-half inch in thickness. All excess fat over the tenderloin should be removed. Care should be taken in pulling loins so as not to score the loin and to leave a smooth covering of fat so that the only trimming necessary is to bevel the fat at the edges of the loin down to the lean.

Jowls: Make dry salt trimmed jowls. Remove all lean meat. The breast flap is to be removed so as to leave not over one inch of the bias flap attached to the jowl.

Plates: Trim out all plates.

Pork Trimmings: Make natural fall from each cut making A's and regular's only.

Feet: Front and hind feet will be weighed as such. No grading necessary.

Note: After the above cuts are made and weights recorded for test purposes, it will be satisfactory to convert any skinned hams necessary into Special Skinned Boiling Hams and the bellies to be converted according to local pork cutting instructions.

CUTTING AND WEIGHING DESCRIPTION

The carcasses were cut after the regular cutting crew of the Columbus Packing Company (Armour and Company) had completed their day's operations. The sample per day consisted of about 25-35 hog carcasses. The carcasses moved on a conveyor to the cutting floor with approximately a 48-hour chill in the coolers, at temperatures ranging from 32 to 36 degrees Fahrenheit. The carcasses were separated first into three main sections, namely, hams, shoulders, and bellies. Three weighing stations were established to receive, weigh and record the total weight of each main section, and a fourth weighing station was set up to handle the loin as it was separated from the belly. All of the scales were inspected and adjusted for accuracy before any weights were recorded.

After the weights of the three main sections were recorded at the respective weighing stations, the additional scales were set up to handle the section containing the loin. As each section was cut up into various wholesale cuts and trimmings, separate weights were taken and recorded for each cut and trimming.

The bellies, hams, and loins were graded both by company graders of the Columbus Packing Company (Armour and Company) and federal graders of the Production and Marketing Administration, United States Department of Agriculture, to indicate grade differences and to indicate whether or not they were suitable for sale as wholesale cuts.

The total weight of all the pork cuts plus trimmings were checked with the original carcass weight for each hog. When there were obvious errors after statistically testing the weighing and recording of the data, the entire carcass was eliminated from the study.

Table A1

AVERAGE WHOLESALE PRICES: PORK CUTS AND TRIMMINGS[1]

November and December, 1948, 1949, 1950 and the

Years 1948, 1949, and 1950 — Chicago

Wholesale cuts	Weight (lbs.)	Nov.-Dec. 1948	Nov.-Dec. 1949	Nov.-Dec. 1950	Year 1948	Year 1949	Year 1950
Fresh skinned hams	10-12	49.89	41.31	45.70	52.02	46.39	45.05
	12-14	48.39	39.04	44.92	51.50	45.76	44.67
	14-16	47.25	38.04	44.34	50.96	45.47	44.50
	16-18	45.81	36.71	43.02	49.07	44.68	44.15
	18-20	45.17	37.81	42.50	47.58	44.12	43.32
	20-22	44.94	37.86	42.75	45.75	42.69	41.89
	22-24	44.92	37.86	42.50	45.36	41.72	40.96
	24-26	44.22	37.19	41.97	42.88	39.14	39.90
	25-30	43.78	33.96	40.22	41.79	36.51	36.92
Fresh loins	8-10	42.06	35.22	39.44	53.46	47.06	45.46
	10-12	42.06	35.22	39.44	53.46	47.06	45.46
	12-16	41.06	34.67	38.94	50.09	44.74	43.62
	16-20	40.17	34.28	38.03	44.69	40.36	39.14
Fresh bellies	6-8	38.75	29.22	31.52	42.94	33.66	31.32
	8-10	38.67	28.17	30.70	42.78	33.21	30.66
	10-12	38.39	26.93	28.95	42.27	31.60	29.64
	12-14	35.56	24.00	26.64	39.55	29.60	28.29
	14-16	34.25	22.51	25.58	37.63	27.96	26.47
	16-18	33.14	21.89	24.05	35.33	26.50	24.75
	18-20	32.11	21.64	23.58	33.47	25.61	24.16
Green fatbacks	6-8	14.78	08.28	11.59	17.29	09.64	09.72
	8-10	15.33	08.39	12.44	17.55	09.75	10.11
	10-12	16.50	09.22	14.67	17.92	09.93	11.04
	12-14	18.72	11.17	15.09	18.88	10.73	11.55
	14-16	19.17	11.94	15.53	19.06	10.93	11.92
	16-18	19.39	12.92	16.23	19.83	11.38	12.64
	18-20	19.39	13.19	16.44	19.83	11.44	12.98
	20-25	19.39	13.19	16.44	19.83	-------	12.98
Fresh picnics	4-6	31.40	24.46	30.28	37.03	30.25	29.91
	6-8	29.99	22.83	28.84	36.06	28.74	28.67
	8-10	29.17	22.15	28.78	33.17	26.66	27.72
	10-12	28.67	21.76	28.77	31.89	25.84	27.33
	12-14	28.49	21.72	28.77	31.42	25.21	27.24
Boston Butts		40.06	30.67	37.44	45.50	38.76	38.75
D.S. Jowl Butts		15.46	08.47	12.52	20.02	11.34	12.51
Spare Ribs (under 3 lbs.)		40.42	32.28	36.125	42.56	37.99	37.41
Neckbones		16.64	08.83	09.84	15.21	11.59	11.30
Front Feet		09.39	06.74	07.52	10.55	07.40	07.50
Regular Pork Trim (50% fat)		22.79	17.03	22.03	28.08	20.49	21.66
Sp. Pork Trim—85%		39.31	35.65	43.14	45.01	39.64	40.93
Ex. Pork Trim—(95%)		48.61	42.94	45.625	50.74	46.66	45.60
Refined Lard (Tierces P.S. Lard)		17.92	09.94	15.25	21.25	12.03	12.75

Conversion of Fat to Lard
(Lard price x conversion factor)

Fat Trimmings and Fatbacks

Table A1 (Cont.)

AVERAGE WHOLESALE PRICES: PORK CUTS AND TRIMMINGS

Wholesale cuts	Weight (lbs.)	Nov.-Dec. 1948	Nov.-Dec. 1949	Nov.-Dec. 1950	Year 1948	Year 1949	Year 1950
Factor[2] Fatbacks							
80.00%	Under 6 lbs.	14.34	07.95	12.20	17.00	09.62	10.20
81.50%	6-8	14.60	08.10	12.43	17.32	09.80	10.39
82.25%	8-10	14.74	08.18	12.54	17.48	09.89	10.49
83.50%	10-12	14.96	08.30	12.73	17.74	10.05	10.65
84.50%	12-14	15.14	08.40	12.89	17.96	10.17	10.77
85.50%	14-16	15.32	08.50	13.04	18.17	10.29	10.90
86.25%	16-18	15.46	08.57	13.15	18.33	10.38	11.00

[1]The average prices for all cuts and trimmings other than loins and Boston Butts were calculated from data taken from the National Provisioner, the weekly trade magazine of the packing industry. The average prices for loin and Boston Butts were calculated from the Chicago Wholesale Meat Situation, furnished by the Production and Market Administration in the United States Department of Agriculture.

[2]The factors for converting fat to lard were copied from the National Provisioner, May 31, 1947, page 25.

a) 10 pounds fatback x 83.5 = 8.35 pounds of lard.

b) 8 pounds fatback x 82.25 = 6.58 pounds of lard.

TABLE A 2

VARIOUS COMBINATIONS OF SIMILAR CORRELATIONS FOR TWO LIGHT WEIGHT GROUPS AND

TWO HEAVY WEIGHT GROUPS OF HOG CARCASSES

	CARCASS WEIGHT GROUPS	AVERAGE BACKFAT	BODY LENGTH	HIND LEG LENGTH	HAM LENGTH	% SKINNED HAMS	% LOINS	% PICNICS	% BUTTS	% BELLIES	WEIGHT OF FOUR LEAN CUTS	TOTAL CARCASS WEIGHT	% LEAN TRIM	% FAT BACK	% FAT TRIM	TOTAL HAM WIDTH	% 5 PRIMAL CUTS
PERCENT OF FOUR LEAN CUTS	125-135	0.8534	0.80908	0.82826	0.80532	0.94423	0.84262	0.68613	0.70771	-0.63649	0.94904	-0.01561	0.17259	-0.90173	-0.72851	0.08279	0.94001
	135-145	0.8842	0.56165	0.84639	0.66010	0.89396	0.78032	0.46597	0.71612	-0.68747	0.95420	0.11140	0.08158	-0.92478	-0.72910	0.09093	0.88988
	175-185	0.7917	0.75474	0.46886	0.51551	0.81938	0.82893	0.73189	0.75384	-0.42011	0.96550	-0.14556	0.21830	-0.65371	-0.74542	-0.08412	0.90956
	185-195	0.4983	0.39267	0.29661	0.54163	0.73066	0.75437	0.59240	0.58952	-0.01315	0.95430	-0.19319	0.05172	-0.64061	-0.70535	-0.18244	0.83109
	374 Hogs	0.81789	0.05578	0.30007	0.20882	0.86125	0.82127	0.65714	0.69636	-0.58950	-0.15912	-0.45913	0.23833	-0.80645	-0.72796	-0.44634	0.84140
AVERAGE BACKFAT	125-135		-0.73421	-0.77341	-0.73542	-0.81376	-0.73138	-0.57716	-0.55769	0.58952	-0.77987	0.11209	-0.31968	0.86497	0.70198	-0.01332	-0.78105
	135-145		-0.49031	-0.61518	-0.61645	-0.80808	-0.67543	-0.39532	-0.65089	0.66892	-0.83285	-0.06015	-0.18100	0.89538	0.56144	-0.03960	-0.75085
	175-185		-0.78383	-0.57103	-0.63433	-0.67599	-0.68109	-0.48604	-0.70708	0.27196	-0.76473	0.12577	-0.32161	0.54751	0.60415	0.01993	-0.75012
	185-195		-0.53125	-0.42896	-0.57159	-0.63750	-0.26933	-0.43572	-0.93582	-0.07329	-0.43161	0.23670	-0.07960	0.73156	0.38741	0.29848	-0.49321
	374 Hogs		0.16988	-0.11161	0.05111	-0.72202	-0.66243	-0.53858	-0.55749	0.51422	0.46523	0.68039	0.32873	0.78342	0.58373	0.65326	-0.67337
BODY LENGTH	125-135			0.82218	0.78406	0.75162	0.76053	0.51176	0.51789	-0.49649	0.83494	0.19150	0.24938	-0.79077	-0.73764	-0.36027	0.77251
	135-145			0.62815	0.59560	0.43106	0.72888	-0.07170	0.38262	-0.54862	0.57040	0.16173	0.08737	-0.52475	-0.21362	-0.27904	0.38901
	175-185			0.56179	0.56177	0.59361	0.67484	0.61451	0.67050	-0.34591	0.24127	0.02292	0.22046	-0.43858	-0.56879	-0.29892	0.67700
	185-195			0.58480	0.60630	0.37252	0.33110	0.60348	0.15582	-0.13058	0.36909	0.07863	0.08259	-0.33819	-0.46022	-0.29143	0.42942
	374 Hogs			0.61750	0.75516	0.00329	0.12268	-0.08660	0.10999	0.45987	0.79837	0.70458	-0.09346	-0.01765	-0.11133	0.54381	0.13774
HIND LEG LENGTH	125-135				0.85172	0.79508	0.71450	0.57649	0.53639	-0.69845	0.83133	0.12495	0.40991	-0.82599	-0.69819	-0.06829	0.70591
	135-145				0.81624	0.45700	0.65754	0.11198	0.40438	-0.67829	0.61558	0.21721	0.35809	-0.62804	-0.29316	-0.16979	0.35422
	175-185				0.85088	0.50087	0.45296	0.31372	0.38661	-0.47351	0.46380	0.13183	0.52277	-0.41780	-0.32109	-0.02842	0.28356
	185-195				0.74589	0.30940	0.26789	0.09798	0.04595	-0.33317	0.21889	-0.25772	0.41755	-0.37322	-0.20537	-0.31417	0.07983
	374 Hogs				0.80421	0.24565	0.31641	0.10819	0.21762	-0.30264	0.47806	0.34558	0.33033	0.28826	-0.23424	0.20780	0.15177
HAM LENGTH	125-135					0.79726	0.60180	0.52143	0.64823	-0.57174	0.77215	0.00292	0.19236	-0.75140	-0.69004	0.03877	0.72898
	135-145					0.52289	0.58608	0.25095	0.53780	-0.45824	0.70892	0.32932	0.03315	-0.59315	-0.52893	-0.10243	0.57426
	175-185					0.52347	0.37455	0.44754	0.45309	-0.33228	0.53803	0.08639	0.26358	-0.47227	-0.42581	-0.08620	0.41916
	185-195					0.60847	0.28192	0.27384	0.21822	-0.13566	0.47570	-0.25272	0.32140	-0.55329	-0.47180	-0.33316	0.35726
	374 Hogs					0.19117	0.17142	0.07522	0.18818	0.03055	0.71762	0.58436	-0.02044	-0.14679	-0.24007	0.44760	0.24538
% SKINNED HAMS	125-135						0.70605	0.64954	0.59669	-0.61559	0.89573	-0.01385	0.19279	-0.87683	-0.72078	0.16191	0.87993
	135-145						0.55782	0.48719	0.46680	-0.57987	0.84221	-0.06481	0.11605	-0.86932	-0.69896	0.22566	0.81914
	175-185						0.56062	0.65730	0.52492	-0.41466	0.78862	-0.12483	0.42247	-0.63102	-0.55262	0.20880	0.71814
	185-195						0.21898	0.48286	0.21208	-0.06270	0.66179	-0.26044	0.08294	-0.73980	-0.45543	0.02859	0.62267
	374 Hogs						0.54881	0.57786	0.46320	-0.49169	0.15495	-0.40927	0.22880	-0.75292	-0.58871	-0.31694	0.73357
% LOINS	125-135							0.40333	0.45785	-0.53634	0.81560	0.03082	0.14514	-0.76290	-0.60033	-0.08188	0.79615
	135-145							-0.04556	0.55201	-0.64600	0.76695	0.15091	0.11614	-0.68946	-0.41861	-0.16510	0.62264
	175-185							0.43899	0.55765	-0.56945	0.80389	-0.11833	0.34702	-0.46133	-0.65678	-0.12874	0.65295
	185-195							0.22491	0.39195	-0.17736	0.74542	-0.05963	-0.01067	-0.35726	-0.46046	-0.28808	0.58598
	374 Hogs							0.31933	0.49366	-0.55919	-0.13296	-0.38038	0.23330	-0.60774	-0.59843	-0.43242	0.64486
% PICNICS	125-135								0.32468	-0.51113	0.67671	0.07058	0.38316	-0.63724	-0.64008	0.13952	0.61179
	135-145								0.13894	-0.21993	0.38265	-0.14027	-0.11264	-0.40372	-0.55303	0.13361	0.47841
	175-185								0.44655	-0.22412	0.71803	-0.06762	0.03832	-0.43012	-0.62392	-0.14770	0.70714
	185-195								0.11202	0.08606	0.51564	-0.28160	0.06003	-0.46628	-0.55173	-0.08104	0.58323
	374 Hogs								0.33978	-0.30477	-0.15640	-0.34856	0.13401	-0.55787	-0.54889	-0.34443	0.60210
% BUTTS	125-135									-0.36479	0.62247	-0.16336	-0.13768	-0.56987	-0.37012	0.03565	0.69991
	135-145									-0.50527	0.72202	0.20864	-0.05971	-0.67664	-0.44699	0.12789	0.63143
	175-185									-0.21439	0.76297	0.03078	0.11302	-0.62858	-0.50055	-0.13921	0.73108
	185-195									-0.11048	0.61136	0.05607	0.04269	-0.08420	-0.52848	-0.05220	0.47248
	374 Hogs										0.03083	-0.24997	0.13106	-0.54369	-0.52177	-0.25882	0.59716
% BELLIES	125-135										0.57645	0.09893	-0.45794	0.60370	0.41030	0.32527	-0.33566
	135-145										0.65953	-0.08086	-0.44692	0.66652	0.20757	-0.04754	-0.28289
	175-185										0.35928	0.23620	-0.68193	0.09292	0.10882	-0.04702	-0.00566
	185-195										0.04089	0.29852	-0.45592	-0.04224	-0.17435	0.25295	0.44182
	374 Hogs										0.32758	0.47526	-0.55222	0.41138	0.24326	0.48189	-0.88388
WEIGHT OF FOUR LEAN CUTS	125-135											0.29919	0.14529	-0.36394	-0.66632	0.19050	0.90572
	135-145											0.40295	0.12741	-0.87560	-0.69726	0.11395	0.84348
	175-185											0.11256	0.23411	-0.67898	-0.74913	0.00494	0.90018
	185-195											0.10802	0.05474	-0.82877	-0.69428	-0.12237	0.94198
	374 Hogs											0.94779	-0.19409	0.19387	0.05861	0.85472	-0.01190
TOTAL CARCASS WEIGHT	125-135												-0.07134	-0.01411	0.09522	0.36504	0.00289
	135-145												0.17703	-0.08897	-0.09229	0.08908	0.00848
	175-185												0.04621	-0.09706	0.00197	0.33432	-0.00497
	185-195												0.01172	0.07703	0.06337	0.21235	0.00297
	374 Hogs												-0.24766	0.42836	0.28374	0.90858	-0.28052
% LEAN TRIM	125-135													-0.32217	-0.54315	-0.31768	0.01309
	135-145													-0.17767	-0.03210	-0.13830	-0.16689
	175-185													-0.15998	-0.02190	0.30789	-0.06744
	185-195													-0.08771	-0.27853	-0.21283	-0.20664
	374 Hogs													-0.30205	-0.30162	-0.25491	-0.05266
% FAT BACK	125-135														0.73399	-0.08506	-0.83736
	135-145														0.56256	-0.10817	-0.80271
	175-185														0.40172	-0.11113	-0.67918
	185-195														0.25058	0.02636	-0.60285
	374 Hogs														0.52242	0.39075	-0.71769
% FAT TRIM	125-135															0.03583	-0.70992
	135-145															-0.01653	-0.83670
	175-185															0.15445	-0.77451
	185-195															0.29430	-0.73762
	374 Hogs															0.31996	-0.73617
TOTAL HAM WIDTH	125-135																0.24183
	135-145																0.09143
	175-185																-0.10953
	185-195																-0.02676
	374 Hogs																-0.25662